GEOLOGY OF THE MERCURY

QUADRANGLE, McCULLOCH

COUNTY, TEXAS

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GEOLOGY OF THE MERCURY QUADRANGLE
McCULLOCH COUNTY, TEXAS

DISSERTATION

Presented to the Faculty of the Graduate School of
The University of Texas in Partial Fulfillment
of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

By

William Adrian Jenkins, Jr., B. S.

THE UNIVERSITY OF TEXAS
June, 1952

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A B S T R A C T

A new map showing detailed geology of the Mercury Quadrangle, and 18 detailed, newly measured and described stratigraphic sections within the quadrangle are the main part of this paper. Lower Ordovician, Mississippian, Pennsylvanian, Cretaceous, and Quaternary strata are exposed. Pennsylvanan beds unconformably overlap older Paleozoic formations, and Cretaceous formations truncate Pennsylvanian strata.

Sandstone and conglomerate channel deposits, occurring at many levels in the Pennsylvanian sequence, are interpreted as indicators of repeated uplift and erosion of nearby land areas. These irregular deposits complicate accurate correlation of marker beds.

Limestone reefs are found in three zones in the upper Canyon series. Interpretation of these limestone masses as reefs permits clarification of several correlation problems. The development of reefs, one above another along northeast southwest trends, suggests shallow, warm, clear-water conditions of deposition.

The nomenclature of the Canyon series is simplified by elevating former member names to formational rank. The Corn Creek limestone member of the Placid formation is the only new name proposed.

Lower Paleozoic beds are folded broadly into the Hall uplift in the southwestern part of the quadrangle. Strawn, Canyon, and Cisco beds, covering 60 percent of the quadrangle, dip northwestward 60 feet per mile, and Cretaceous strata in the southwestern part of the area dip southward 10 feet per mile.

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I N T R O D U C T I O N

The Colorado River valley in the vicinity of the Mercury Quadrangle has been a classic area for the study of Pennsylvanian stratigraphy since the first geological survey of Texas in 1890. The present study contains a detailed map of the Mercury Quadrangle showing all of the traceable stratigraphic units coordinated with carefully measured geologic sections. Particular attention has been given to the mapping of previously neglected Pennsylvanian channels and reefs. Widespread channelling of the uppermost Strawn limestone makes it difficult to define the Strawn-Canyon boundary across the quadrangle. The correlation of the basal Canyon conglomerate (Rochelle) with equivalent beds to the north is complicated by channelling and by facies changes. Rapid facies changes associated with limestone reefs in upper Canyon strata are now recognized as part of the problem of questionable and erroneous correlations made in those beds by previous workers.

Although nomenclature and correlation problems will continue to be encountered as mapping and faunal studies are made in greater detail, an attempt has been made in this report to simplify the nomenclature of Pennsylvanian strata exposed in the Colorado River valley.

The Mercury Quadrangle is in central Texas about 20 miles northeast of the town of Brady (Figure 1). The quadrangle is mainly in McCulloch County but it includes portions of San Saba, Brown, and Coleman Counties. Although the only highway crossing the quadrangle is U. S. Highway 283 between Brady and Brownwood, numerous farm to market roads and ranch roads make the entire area easily accessible.

The oldest exposed rocks are in the southeastern corner of the quadrangle and represent a small portion of the folded and faulted Llano uplift. Strawn and Canyon beds, dipping gently northwest, are exposed over the greater part of the quadrangle. Cisco rocks crop out in the extreme northwestern corner of the quadrangle. Nearly horizontal Lower Cretaceous beds overlie uncomformably the Strawn and Canyon in the southwest and south-central part of the quadrangle.

The first geological work in the Mercury Quadrangle was done by Tarr (1890) in a report on the coal fields of the Colorado River. He classified only the broader divisions of the Pennsylvanian rocks. In the same year, Dumble (1890) classified equivalent rocks outcropping in the Brazos River valley and correlated them with Tarr's divisions to the south. During the following year, Cummins (1891), expanding the work of Tarr and Dumble in both the Colorado and Brazos River valleys, modified the classification of Dumble and applied the Brazos River valley names of Strawn, Canyon, and Cisco

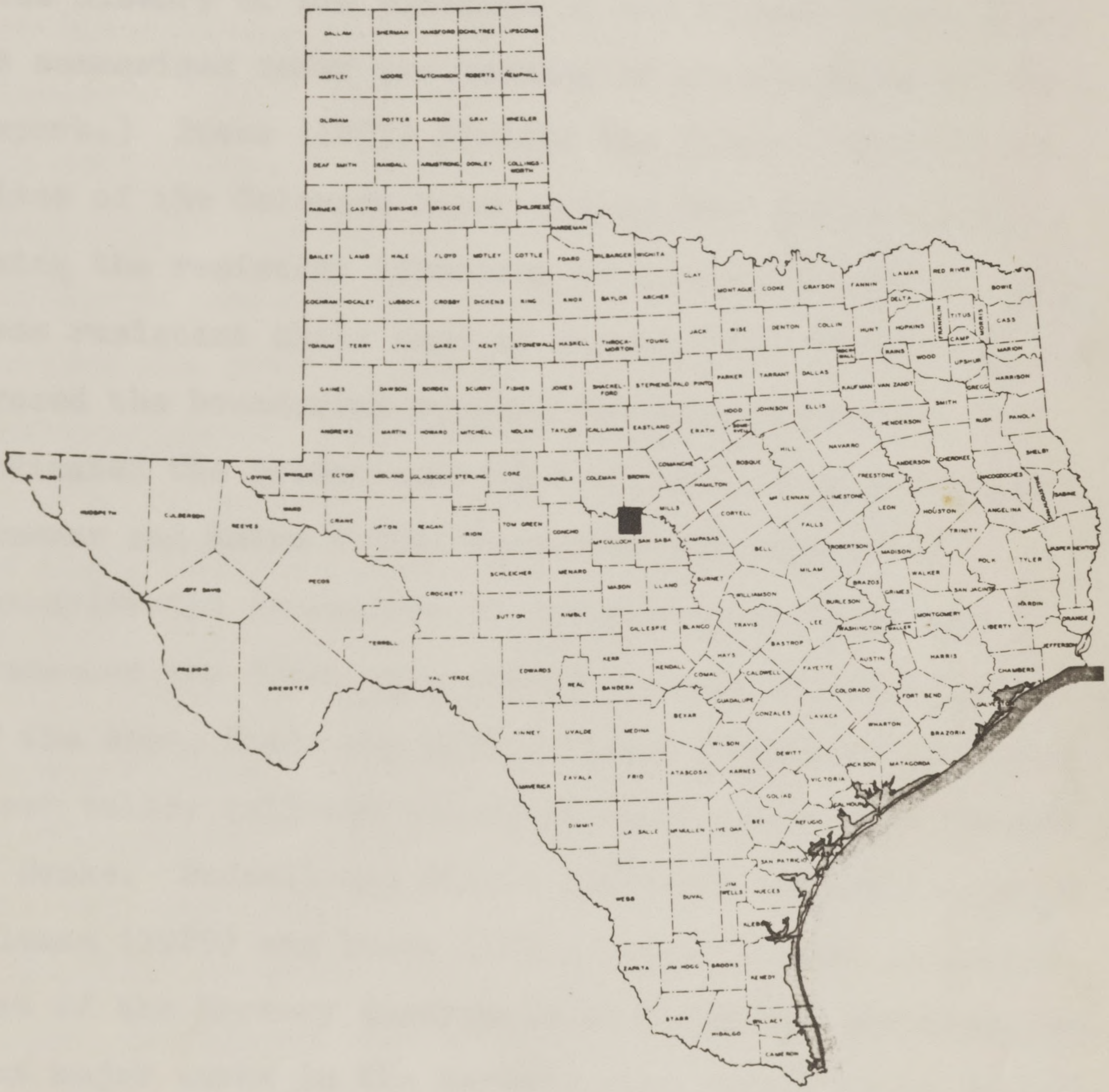

Figure 1. - Index map showing location of Mercury Quadrangle.

to beds of equivalent age in the Colorado River valley. Various writers have since disagreed on the position of the Strawn-Canyon boundary and the Cisco-Wolfcamp boundary. (The history of the position of the Strawn-Canyon boundary is summarized under the heading of stratigraphy in this report.) Drake (1893) divided the Strawn, Canyon, and Cisco of the Colorado River valley into smaller units using the resistant limestone or sandstone beds and the less resistant shale beds as formations. On his map he traced the boundaries between the major divisions and indicated the predominant kind of rock in each division. Plummer and Moore (1922) described and mapped the Pennsylvanian formations of north-central Texas and presented the first comprehensive study of the paleontology of the area. Their map of the Pennsylvanian in the Colorado River valley followed the previously established boundaries of Drake. Hudnall and Pirtle published geologic maps of Coleman (1929) and Brown (1931) Counties including that part of the Mercury Quadrangle in these two counties. The next major works in the Mercury area were done by Bullard and Cuyler (1935) who mapped a narrow strip south of the Colorado River from Mercury westward to the McCulloch County line, and Nickell (1938) who mapped a corresponding area north of the river. Both reports contain detailed measured sections and well defined stratigraphic boundaries. The Coleman County map of 1929 was revised by Plummer *et* al (1937) but added no additional geologic knowledge to the Mercury Quadrangle. Cheney (1940) assembled subsurface information of north-central Texas and proposed changes in the nomenclature of the various stratigraphic units. Plummer's (1950) posthumous work assembled detailed and reconnaissance data on the Carboniferous of the entire Llano region and included some details of the southern portion of the Mercury Quadrangle. Cheney and Eargle (1951) revised the geologic map of Brown County, which includes the northern part of the Mercury Quadrangle.

The present work was carried on during the summers of 1948, 1949, and 1950. The measuring of the stratigraphic sections and mapping were completed in 1951.

The base map was drawn from the U. S. Geological Survey 15-minute topographic sheet of the Mercury Quadrangle (1950), scale 1:24,000. This was supplemented by the use of stereographic pairs of vertical aerial photographs, scale 1:20,000. Wherever stratigraphic contacts were well exposed, elevations were determined by means of an altimeter and fixed to the topographic control of the base map. (The limits of error in the use of the altimeter were within plus or minus three feet of the instrument reading.) All geologic sections were measured with a hand level and staff. Descriptive terms for colors of rocks are from the "Rock-color Chart" (Goddard, et al, 1948). Grain-size terminology of carbonate rocks proposed by DeFord (1946, pp. 1921-1928) and grain-size terminology of non-carbonate rocks proposed by Wentworth (1922) are used in the lithologic descriptions.

A C K N O W L E D G M E N T S

I wish to express my appreciation to the many who have made this dissertation possible: my doctoral committee - Samuel P. Ellison, Jr., Hal P. Bybee, Ronald K. DeFord, B. C. Tharp, and Charles Heimsch; the ranchers for their interest and cooperation; and the Stanolind Oil and Gas Company for the scholarship which helped defray field expenses.

Dr. Ellison not only gave many helpful suggestions and criticisms during the writing of the manuscript but also gave freely of his personal time for valuable assistance in the field during the mapping of the area.

For stimulating discussions of field problems and for use of the large-scale base map, I wish to thank D. Hoye Eargle of the United States Geological Survey.

Residence in the field was made much more enjoyable by the generosity of A. L. Finnegan and Parker Pumphrey. Mr. Pumphrey also kindly furnished subsurface information which otherwise would have been unobtainable.

Without the continual help and encouragement of my wife, Margaret Shirling Jenkins, in the preparation of the manuscript and throughout all phases of the work, this study would have been impossible.

P H Y S I O G R A P H Y

The Colorado River meanders across the northern part of the Mercury Quadrangle with apparent disregard for the kind of rock over which it flows. In the western half of the quadrangle, the rocks are predominantly hard limestones and interbedded shales of the Canyon series. Here the flood plain of the Colorado is narrow and steep bluffs line its course. In the central area, the Colorado flows through the less resistant Brownwood shale making a wide flood plain. In the east, the river flows through more resistant Strawn sandstone forming high bluffs and a narrow flood plain. The physiography of the Mercury Quadrangle suggests that the river is superimposed or antecedent for its course is only slightly modified by the hard and soft beds over which it flows.

In contrast to the Colorado River, the courses of its tributaries are controlled directly by hardness and softness of the underlying rocks. The major tributaries such as Deep Creek and Corn Creek flow north occupying positions parallel to the strike of the underlying beds. Deep Creek is on the soft Brownwood shale and Corn Creek flows along the soft shale beds of the Winchell formation. A series of east-facing cuestas capped by resistant limestones is found east and west of the larger tributaries. The drainage pattern to the east of Deep Creek has become more homogeneous and fine-textured because the sandstones lack definite hard and soft layers. The cuestas made by these sandstones are low and thoroughly dissected. Richland Springs Creek in the southeast follows the contact between the Big Saline formation and the Strawn. Drainage patterns around the high, flat-topped Cretaceous hills in the southwest and south-central part of the quadrangle are radial.

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S T R A T I G R A P H Y

LOWER ORDOVICIAN

Ellenburger Group

Nomenclature. - The original use of the name "Ellenburger limestone" by Paige (1912, p. 51) was redefined by Cloud, Barnes, and Bridge (1945), and Cloud and Barnes (1948). The redefined Ellenburger group is restricted to the Lower Ordovician and divided into three formations, from oldest to youngest: the Tanyard, the Gorman, and the Honeycut formations. Only rocks of the Gorman formation outcrop in the Mercury Quadrangle. The Honeycut formation is absent west of 98° 55' longitude because of post-Ellenburger truncation (Cloud and Barnes, 1948, p. 40.).

Gorman formation. - The upper part of the Gorman formation is exposed in the southeastern part of the quadrangle in the Hall uplift, an anticline whose axis plunges northeast under overlapping Strawn beds. The overlying Mississippian system and Bend series are also involved in the folding of the anticline, but the adjacent Strawn beds overlap unconformably the fringes of this older structure.

Less than 75 feet of the Gorman formation is exposed in the Mercury Quadrangle. The rocks are massive calcareous limestone and cherty limestone, belonging to the upper calcitic facies of the formation. Stromatolites are found in a few layers near the southwestern limits of the Gorman outcrop. A typical section of the Gorman formation measured southwest of Hall, Texas, is graphically shown in Figure 2.

The reasons for assigning the Ellenburger rocks of the Mercury Quadrangle to the upper calcitic facies of the Gorman formation are the presence of:

1. The gastropod Lecanospira (restricted to the Gorman in the Llano region);
2. Cryptograined calcitic limestone containing nodular and concretionary porcellaneous chert;
3. Quartz sand sparsely scattered throughout the limestone;
4. Stromatolites (characteristic of the upper Gorman).

Differences in vegetation make the contact between the Gorman formation and the Barnett shale distinct on aerial photographs (Figure 3). The intervening Ives breccia supports vegetation similar to the underlying Gorman. Plants growing on the Gorman formation consist of scattered live oaks or

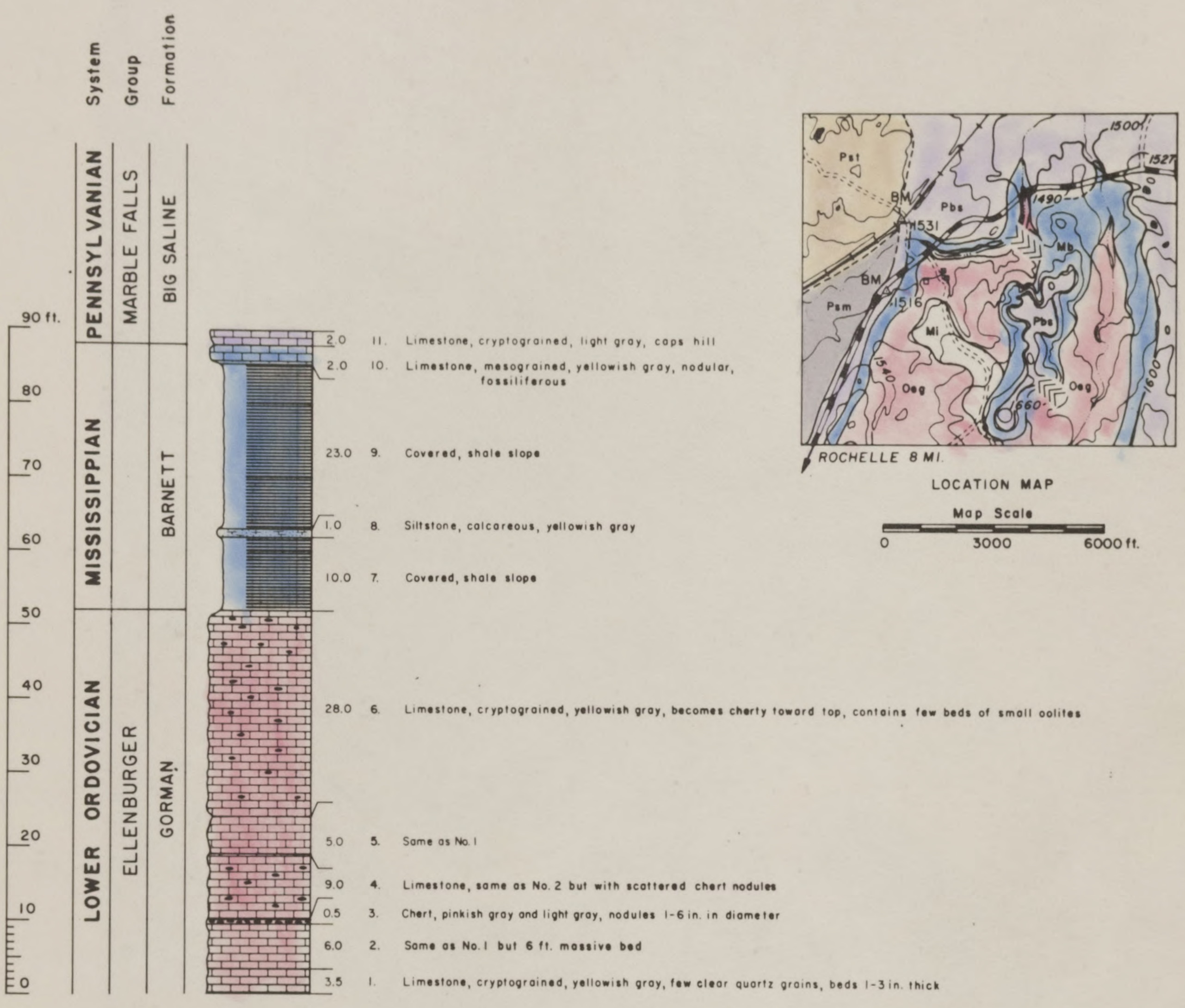


Figure 2. - Section of Gorman and Barnett formations 2 miles southwest of Hall, San Saba County, Texas.

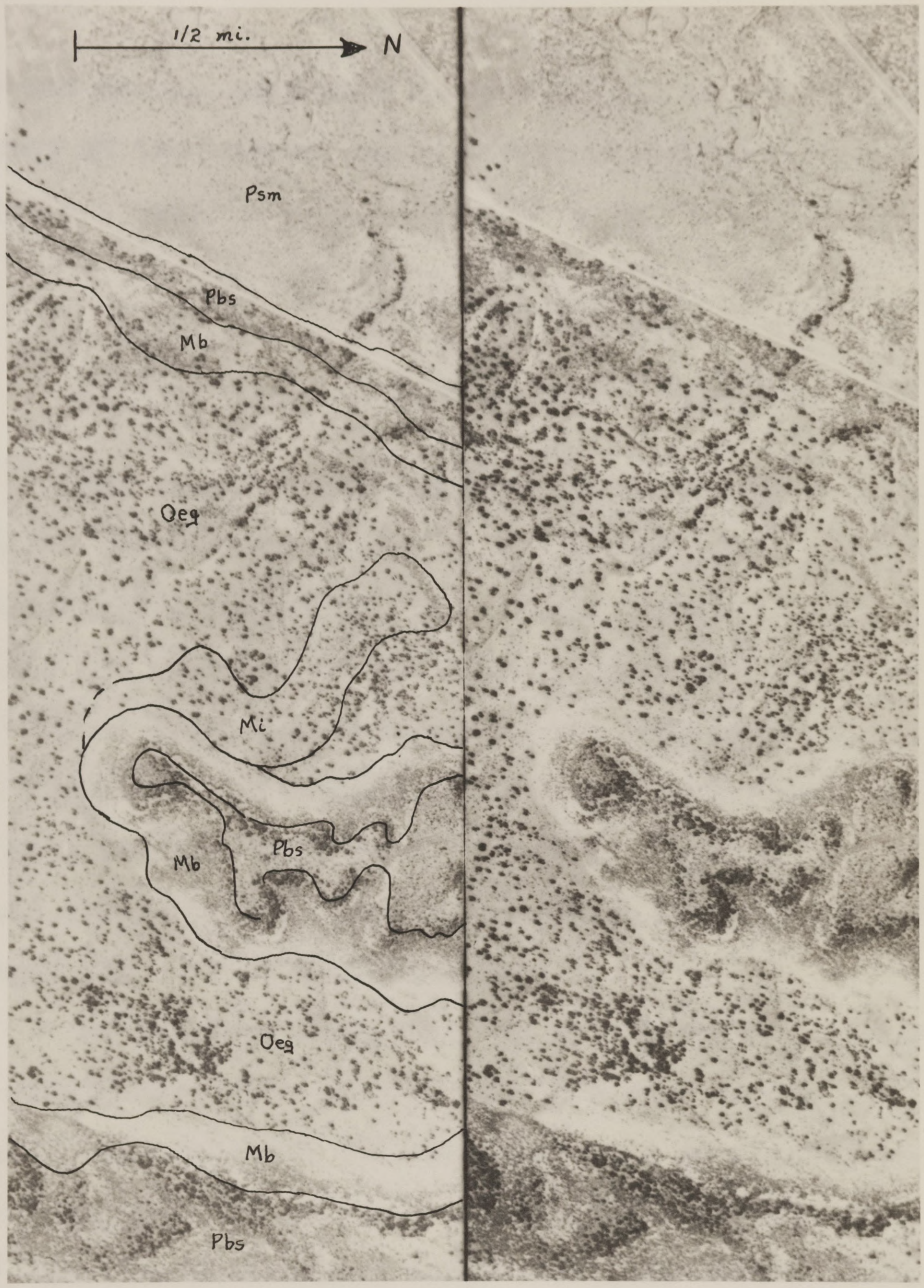


Figure 3. - Stereogram of Gorman, Ives, Barnett, Big Saline, and Smithwick formations southwest of Hall, San Saba County, Texas. Oeg indicates Gorman formation; Mi, Ives breccia; Mb, Barnett shale; Pbs, Big Saline formation; and Psm, Smithwick shale.

live-oak mottes separated by open grassland. In contrast, the outcrop of the Barnett shale is either barren or covered with mesquite trees.

MISSISSIPPIAN SYSTEM

Ives Breccia

The Ives breccia was first described by Plummer (Bullard and Plummer, 1939, p. 15) as the basal conglomerate of the Chappel formation. In a later report, Plummer (1950, pp. 26, 27) referred to the Ives conglomerate as a member of the Chappel formation designating the type locality "...along Ives Branch on the Gibbons ranch 2½ miles southwest of Hall..., San Saba County" (southeastern Mercury Quadrangle). Cloud and Barnes (1948, p. 46) raised the unit to formational rank and changed the name to Ives breccia.

At the type locality, the Ives breccia is a one-foot bed of angular chert phenoclasts in a sand matrix; the cement is siliceous, binding the sand and chert so tightly that the rock fractures across the phenoclasts and matrix. The light gray, angular phenoclasts range from less than a millimeter to 8 centimeters in diameter, and the light brown matrix consists of rounded to subrounded, medium-grained, quartz sand. At some places the sand matrix is interstitial between the phenoclasts; at others, the matrix constitutes over 50 percent of the rock.

The Ives breccia forms a dip slope on its upper surface, cropping out over an area 0.75 mile long and 0.25 mile wide. It rests unconformably on an old erosional surface of the Gorman formation. The Barnett shale disconformably overlies the Ives breccia.

Outcrops of chert breccias correlated with the Ives breccia are scattered throughout the Llano region. Its outcrop is less continuous than that of the Chappel limestone with which it is usually associated. Cloud and Barnes (1948, pp. 48, 49) stated that the Ives breccia is probably Lower Mississippian, on the basis of fossils and field relationships. Conodonts collected at the type locality and their stratigraphic ranges are as follows:

<u>Palmatolepis</u> . . . . Devonian

<u>Nothognathella</u> (?) . . . . Upper Devonian

<u>Pinacognathus</u>. . . . . Mississippian

<u>Ozarkodina</u> . . . . Ordovician to Permian

This assemblage of condononts is interpreted as a mixed assemblage of Mississippian age.

Barnett Shale

The Barnett shale was first described by Plummer and Moore (1921, p. 24) from outcrops at Barnett Springs, San Saba County. The Barnett shale of their definition included all shale and limestone beds between the Marble Falls limestone and the Ellenburger limestone. Roundy, Girty, and Goldman (1926, p. 2) discovered a limestone (Chappel of Sellards) containing a Lower Mississippian fauna between the Barnett and Ellenburger. Sellards (1933, p. 92) redefined the Barnett to include all Mississippian beds between the Chappel formation (or older deposits where the Chappel is absent) and the Marble Falls limestone. This definition is now used by most geologists working in the Llano region.

The Barnett shale in the Mercury Quadrangle overlies either the Gorman formation or the Ives breccia. The Chappel limestone is absent. Outcrops of the Barnett shale in the Mercury Quadrangle are all deeply weathered, forming slopes of thinly laminated yellowish gray shale (unweathered outcrops are typically black or dark brown.) A representative geologic section of the Barnett shale exposed in the quadrangle is shown in Figure 2.

The Barnett shale crops out in a narrow band along the axis and on the flanks of the Hall uplift and at the extreme southeastern corner of the quadrangle. Most of these less resistant shale outcrops form a barren slope underneath the hard ledges of the Big Saline limestone. The vegetation growing on the Barnett consists of mesquite trees on the lower more gentle slopes whereas the upper steeper slopes are barren or covered with grass. The bottom and top of the formation are easily distinguished on the aerial photographs (Figure 3).

PENNSYLVANIAN SYSTEM

The classification and nomenclature of the Pennsylvanian system have been the subject of much controversy among geologists who work in different sections of Texas. In this report, the nomenclature of the major divisions of the Pennsylvanian follows Plummer (1950) with some modifications in terminology. A comparison of the nomenclature used herein with the standard section in the midcontinent region, as well as with Cheney's (1940, p. 66) divisions, is as follows:

Texas (This report)	Midcontinent Region	Texas (After Cheney, 1948)
Cisco series	Virgil series	Cisco series
Canyon series	Missouri series	Canyon series
Strawn series	Des Moines series	Strawn series
Bend series	Atoka series	Lampasas series
Morrow series	Morrow series	Morrow series

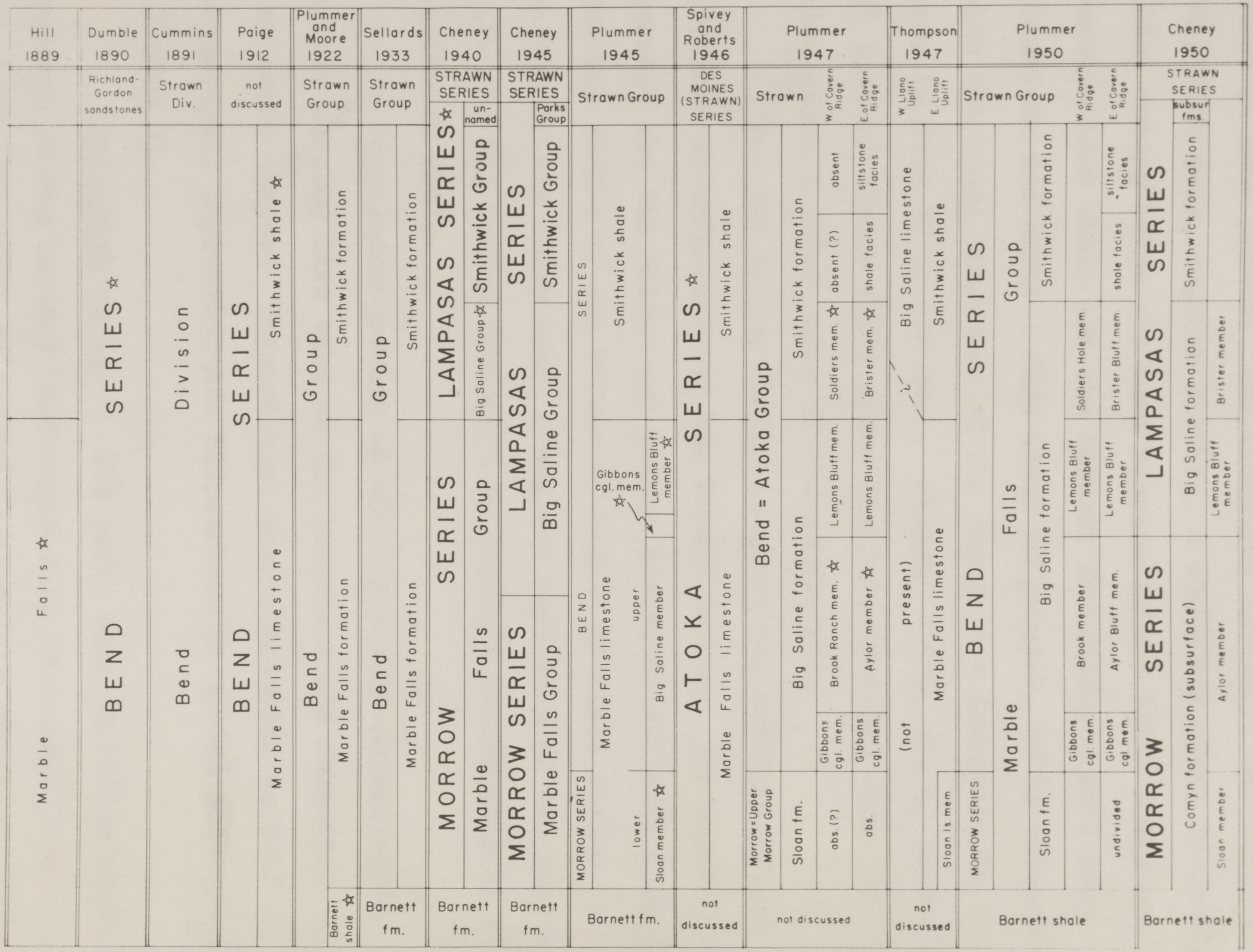
Approximately 1200 feet of Pennsylvanian strata belonging to the Bend, Strawn, Canyon, and Cisco series crop out over the greater part of the Mercury Quadrangle. Information derived from logs of water wells and oil tests shows that these beds also underlie the thin Cretaceous and Quaternary formations which cover a part of the area. The Bend series (gray limestones and black shale) is exposed in the southeast corner of the quadrangle; the Strawn series (thick sandstones and shales), in the east half of the quadrangle; the

Canyon series (alternating thin limestones and thick shales), in the west half of the quadrangle; and the Cisco series (alternating thin limestones and thick shales), in the extreme northwest corner of the quadrangle.

Bend Series

Nomenclature.- A chronological summary of the history of nomenclature and classification of the Bend series is shown in Figure 4. The classification used in this report follows Plummer (1950).

Big Saline formation. - The oldest rocks of the Bend series exposed in the Mercury Quadrangle are correlated with the Lemons Bluff limestone member of the Big Saline formation. The Brook and Aylor Bluff members (absent in the Mercury Quadrangle) pinch out towards the Hall uplift and the Richland Springs axis (about 2.5 miles east of the southeast corner of the Mercury Quadrangle). Near these uplifts, the Lemons Bluff member may rest unconformably on the Barnett shale. Elsewhere, according to Plummer (1950, p. 68), the Lemons Bluff overlies unconformably older Big Saline rocks. Plummer stated that the Lemons Bluff thins by loss of lower beds over uplifts and reefs in the Aylor Bluff member. The Lemons Bluff member consists of cryptograined to meso-grained, medium gray limestone beds containing dark gray, nodular, and bedded chert. The limestone beds are from 3 inches to 12 inches thick and are interbedded with thin



☆ — FIRST USE OF NAME IN LITERATURE

Figure 4. - History of the correlation of the Bend Series, 1889 to 1950.

shale at some places. The limestone weathers into smooth, yellowish gray, angular blocks. A shale bed about 25 feet thick occurs below the more massive Lemons Bluff limestone. Between this shale and the Barnett formation, a dark gray limestone bed about 3 feet thick is present. It is estimated that the total thickness of the Big Saline formation in this area is from 75 to 100 feet. Plummer (1950, pl. 9) measured 65 feet of Lemons Bluff along the McCulloch-San Saba County line about 4 miles south of the quadrangle.

The Big Saline formation along its northern extent is overlain unconformably by the Strawn series. The unconformity between the Big Saline and Strawn series is definitely angular for the strike of the Strawn is almost at right angles to the strike of the older beds. Along the west side of the Hall uplift the Big Saline formation is overlain conformably by the Smithwick shale.

Vegetation growing on the Big Saline formation is mainly scrubby live oaks on the limestone and mesquites on the shale slopes. Vegetational characteristics as well as topographic expression are illustrated in aerial photographs (Figure 3).

Smithwick shale. - The soft, dark Smithwick shale, present in the Mercury Quadrangle only in a small area west of the Hall uplift, is poorly exposed; its extent is inferred from the vegetation and topographic expression. The estimated thickness exposed in the quadrangle is from 0 to 75 feet. The Smithwick is not exposed north and east of the Hall uplift because of overlap by younger Strawn beds. It is known in wells to the north and east below the Strawn.

Strawn Series

<u>Nomenclature</u>. - The early history of the classification of the Strawn series is shown in Figure 5. Subsequent changes in the classification of the Strawn in the Colorado River valley are shown below and in Figure 11.

Writer	Top of Strawn	Base of Strawn
Plummer and Moore (1922)	Base of Rochelle conglomerate	Top of Bend
Hudnall and Pirtle (1931)	Base of Palo Pinto limestone	————————
Bullard and Cuyler (1935)	Base of Rochelle conglomerate	Top of Bend
Nickell, C. O. (1938)	Base (See p. 98 & Plate VIII of Bull. 3801) D.N.E. ~~Top~~ of Palo Pinto (?) limestone	————————
Plummer, F. B. (1950)	Base of Rochelle conglomerate	————————
Cheney and Eargle (1950)	Top of Capps limestone	————————
Cheney (1950)	Top of Capps limestone	Top of Big Valley beds (?) of Drake
This report (1952)	Top of Capps limestone or base of Rochelle conglomerate	Top of Bend

<table>
<tr><th colspan="5">COLORADO RIVER VALLEY</th><th colspan="2">BRAZOS RIVER VALLEY</th></tr>
<tr><th>This report</th><th>Dumble 1890
Tarr 1890</th><th>Cummins 1891</th><th colspan="2">Drake 1893</th><th>Dumble 1890</th><th>Cummins 1891</th></tr>
<tr><td rowspan="2">CISCO SERIES</td><td rowspan="2">WALDRIP SERIES</td><td rowspan="2">Cisco division</td><td colspan="2">Cisco division</td><td rowspan="2">CISCO SERIES</td><td rowspan="2">Cisco division</td></tr>
<tr><td rowspan="4">Canyon division</td><td>12. Campophyllum bed
11. Bluff Creek bed</td></tr>
<tr><td rowspan="3">CANYON SERIES</td><td>BROWNWOOD SERIES</td><td>Canyon division</td><td>10. Home Creek bed
9. Hog Creek bed
8. Cherty limestone bed
7. Bed No. 7
6. Clear Creek bed
5. Cedarton bed
4. Adams Branch limestone</td><td>RANGER SERIES</td><td>Canyon division</td></tr>
<tr><td>MILBURN SERIES</td><td rowspan="4">Strawn division</td><td>3. Brownwood bed</td><td>STRAWN SERIES</td><td rowspan="3">Strawn division</td></tr>
<tr><td>Rochelle conglomerate</td><td>2. Rochelle conglomerate
1. Coral limestone bed</td><td rowspan="3">Gordon sandstone</td></tr>
<tr><td rowspan="2">STRAWN SERIES</td><td rowspan="2">Richland sandstone</td><td rowspan="2">Strawn division</td><td>23. Ricker bed
22. Indian Creek bed
21. Antelope Creek bed
20. Comanche Creek bed
19. Wilbarger Creek bed
18. Buffalo Creek bed
17. Rough Creek bed
16. Hanna Valley bed
15. Cottonwood Creek bed
14. Spring Creek bed
13. Brown Creek bed
12. Big Valley beds
11. Bull Creek sandstone
10. Horse Creek clays and shales</td></tr>
<tr><td>9. Fox Ford bed
8. Bed No. 8
7. Shadrick Mill sandstone
6. Elliott Creek bed
5. Burnt Branch bed
4. Lynch Creek bed</td><td>Millsap division</td></tr>
<tr><td>BEND SERIES</td><td>Bend division</td><td>Bend division</td><td colspan="2">Bend division</td><td></td><td></td></tr>
</table>

Figure 5. - History of the correlation of the Strawn Series, 1890 to 1893.

Drake (1893) divided the Strawn sequence of the Colorado River valley into 20 units (Figure 5) using the alternating sandstones and shales as the basis for his classification. No major changes have been made in this classification to the present. In this report, no attempt has been made to map the Strawn in detail because of rapid facies changes and lateral discontinuity of individual beds. The classification of Drake has been followed wherever his units are recognizable. An estimated 300 feet of Strawn is exposed in the Mercury Quadrangle. The Strawn units mapped by Drake in the Mercury Quadrangle are listed below:

Units mapped by Drake (1893)	Units mapped in this report
Coral limestone bed	Capps limestone
Ricker bed (sandstone)	Strawn undifferentiated
Indian Creek bed (shale)	
Antelope Creek bed (sandstone)	
Comanche Creek bed (shale)	

Strawn undifferentiated. - Strawn beds below the Capps limestone member are exposed in the western half of the quadrangle. The Travis Peak formation, forming a large outlier, covers the Strawn in the south-central part of the area. Along the edge of the Llano uplift in the southeast, the Strawn unconformably overlaps the Big Saline and Smithwick formations. Southwest of the Mercury Quadrangle near Rochelle, the Strawn is overlapped by Canyon beds which rest directly on the Bend series. The strike of the Strawn beds is about N 20° E, and the dip is northwest. It is difficult to determine the amount of northwest dip because of the lenticular shape and discontinuity of beds. Measurements made from well logs and at the surface indicate a dip of about 1° . The thick sandstones exposed on the surface thin rapidly downdip in the subsurface. As a result, Strawn sandstones encountered in wells to the west and northwest are thin. Although the Strawn below the Capps limestone has not been subdivided, a brief description of the beds in the quadrangle equivalent to Drake's units is given below.

The lowest bed of Drake's classification in the Mercury Quadrangle ("Comanche Creek bed") crops out in the broad valley occupied by the heads of Mountain Creek and Wilbarger Creek. The upper gray-shale portion of the "Comanche Creek bed" is exposed along the east side of the Cretaceous outlier in the vicinity of Round Mountain. At Round Mountain the shale is more than 100 feet thick. A 10- to 15-foot sandstone underlies the upper shale, forming a ridge which extends from a point 3 miles northeast of Hall to the Colorado River. Figure 6 shows the vegetation and topographic expression of the "Comanche Creek bed" and the overlying Travis Peak (Cretaceous) formation.

Beds equivalent to Drake's "Antelope Creek bed" form

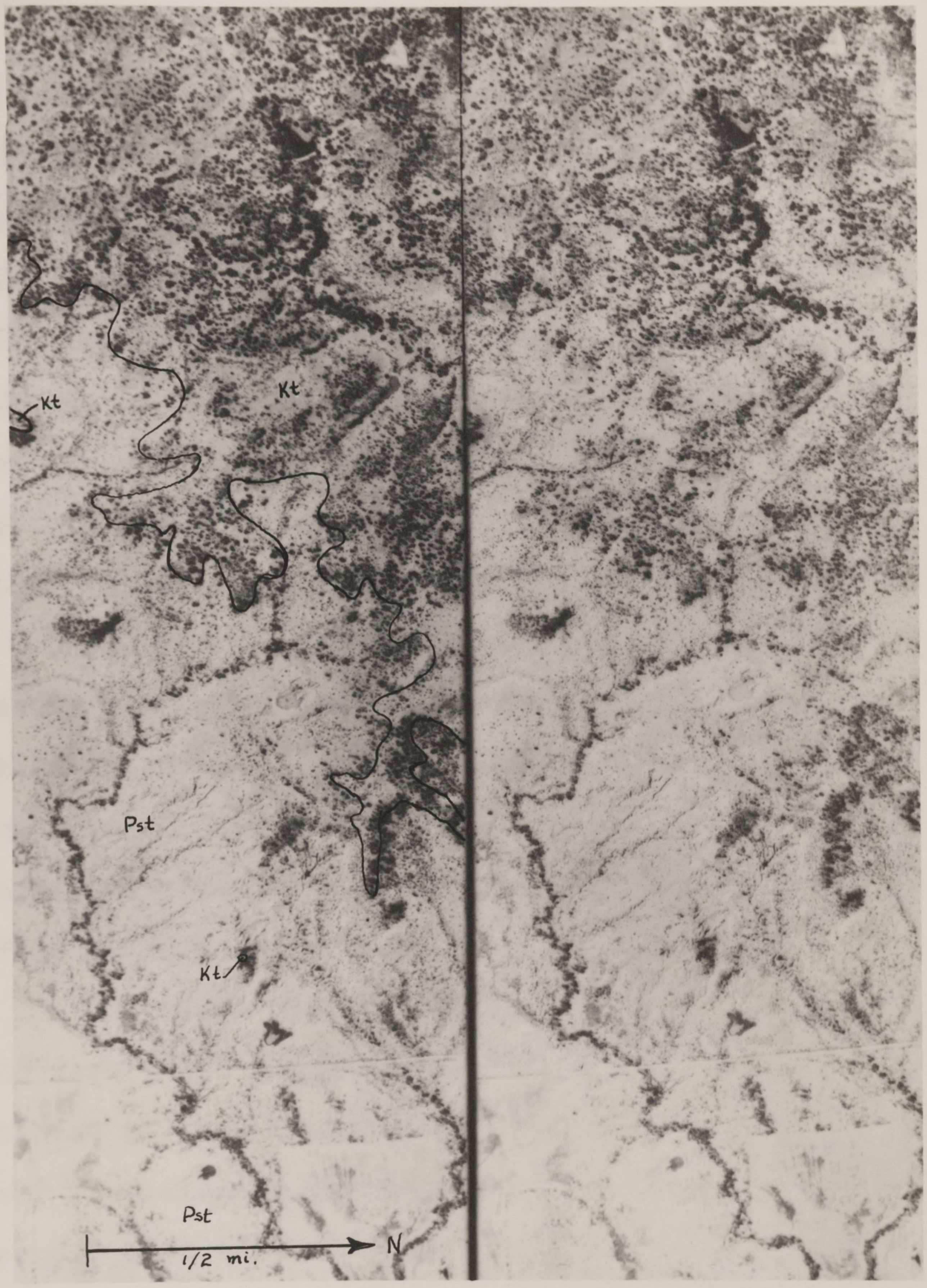


Figure 6. - Stereogram of Strawn series and Travis Peak formation (Lower Cretaceous) north of Hall, San Saba County, Texas. Pst indicates Strawn undifferentiated (mostly "Comanche Creek bed"); and Kt, Travis Peak formation.

high bluffs along the Colorado River downstream from Keys Crossing Ford. To the south, the upper part of this sandstone merges with the base of the "Ricker bed." The lowest stratum of the "Antelope Creek bed" can be traced just below the base of the Travis Peak formation along the Cretaceous escarpment southwest of Holt Church. Thin-bedded, yellowish gray sandstone as well as massive, lenticular, channel-like sandstone containing plant fossils occurs in the "Antelope Creek bed." Most of the strata are cross-bedded and contain ripple-marks.

Drake's "Indian Creek bed" is exposed north of Keys Crossing Ford below the escarpment formed by the overlying "Ricker bed." South of the Colorado River this shale either changes laterally into sandstone or thins rapidly and disappears. A geologic section of a part of the "Indian Creek bed" is given in Figure 7.

The basal beds of Drake's "Ricker bed" form a sandstone escarpment which can be traced from a point 1.5 miles northeast of Keys Crossing Ford south along Buzzard and Brushy Mountains to the northernmost outcrop of the Cretaceous. The upper part of the "Ricker bed" is a shale which can be traced south on the east side of Deep Creek. Representative geological sections of the "Ricker bed" are shown in Figures 7, 8, and 9. The lower sandstone part of the section contains thick channels, chert conglomerate, and massive lenticular sandstones. The channel conglomerates are well developed near the mouth of Clear Creek and along Oldham Hollow and Rough Branch (south of Milburn). Conglomerate beds are found in the upper shale bed south of Milburn. The upper shale interval is overlain by the Capps limestone or its facies. A limestone conglomerate is present near the base of the shale, cropping out in the bed of the Colorado River 0.5 mile downstream from Beasley Crossing. Near the measured section (Figure 9) 4 miles southeast of Placid, Plummer (1950, pp. 96, 98) listed 9 species of fossils from this shale. He incorrectly placed the shale in the Canyon (Brownwood shale). The fossils listed by Plummer are included in Table 1.

Capps limestone member. - The Capps limestone member forms isolated outliers in three areas near the Colorado River: 0.75 mile north of the mouth of Limekiln Creek, west of Elm Grove on both sides of Limekiln Creek, and 0.5 to 2 miles south of Milburn along the ridge west of Oldham Hollow. The most nearly complete section of the Capps exposed in the quadrangle is north of the mouth of Limekiln Creek (Figure 8). Elsewhere only the lower beds of the Capps limestone occur on the tops of hills. At the mouth of Clear Creek, the Capps is channelled and replaced by sandstone or chert conglomerate. Between the outcrop north of the Colorado River and those to the south, the Capps is absent because of channelling or is covered by alluvium. South of Milburn the Capps limestone occurs as discontinuous outcrops between channel deposits. South of its last outcrop, the Capps changes facies, grading laterally into thin-bedded medium-grained sandstone. This sandstone can be followed along the bluff east of Deep Creek to a point where it appears to be channelled by the Rochelle conglomerate. At other places north of the Rochelle outcrop, the sandstone facies of the Capps is locally replaced by massive cross-bedded sandstone or chert conglomerate (Figure 18). This sandstone or conglomerate may represent basal Brownwood channels, or channels which begin within the Capps limestone interval.

Fossils are not common in the Capps limestone in the Mercury Quadrangle. _Chaetetes_ reefs are present 0.5 mile west of Elm Grove and north of the mouth of Limekiln Creek. _Fusulina_ is present in the lower beds of the Capps south of Milburn where the cross-section line AB intersects the west margin of the outlier.

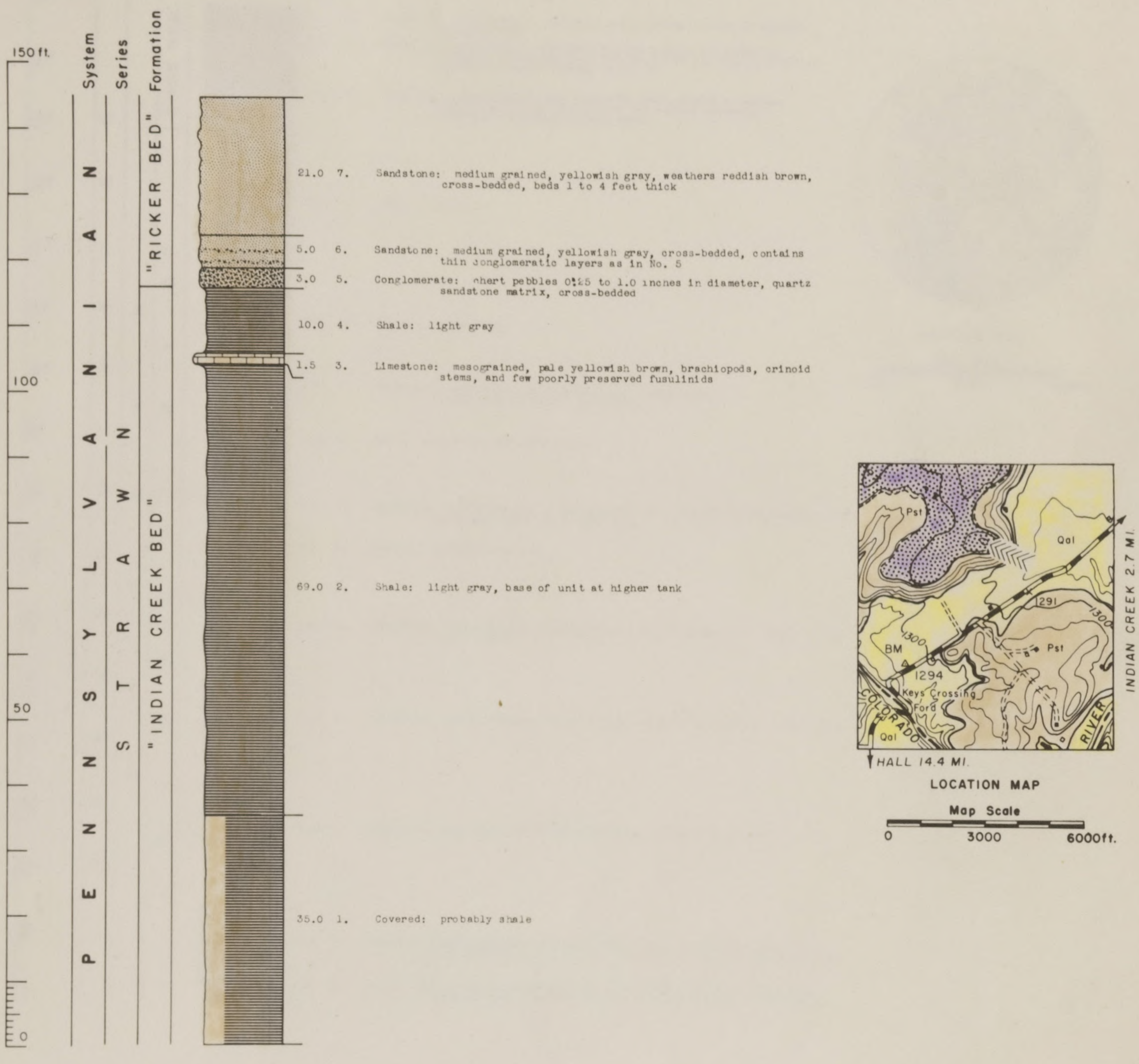


Figure 7. - Section of part of Strawn series ("Indian Creek bed" and "Ricker bed") 1 mile northeast of Keys Crossing Ford, Brown County, Texas.

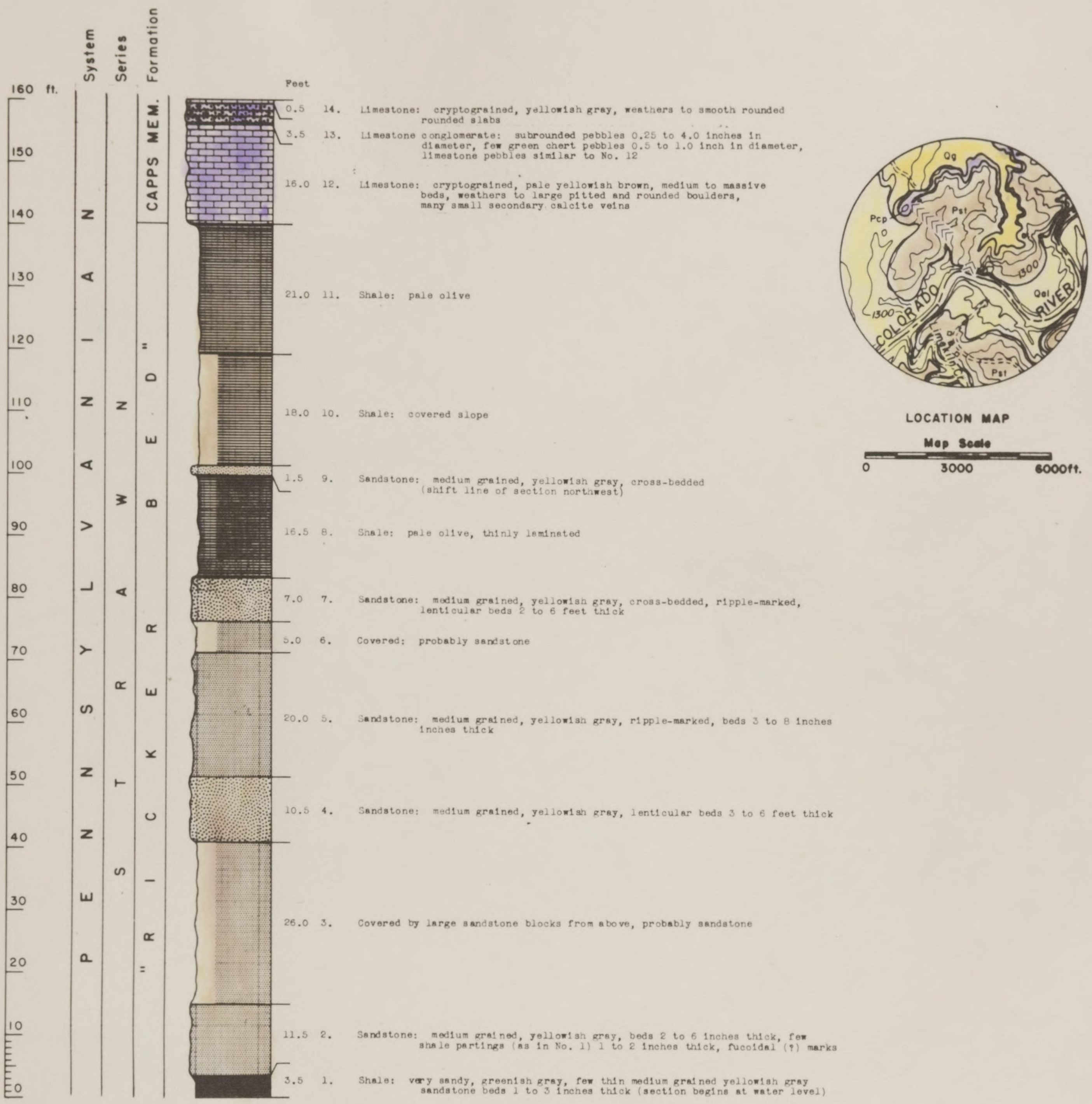


Figure 8. - Section of part of Strawn series ("Ricker Bed" and Capps limestone north of mouth of Limekiln Creek, Brown County, Texas.

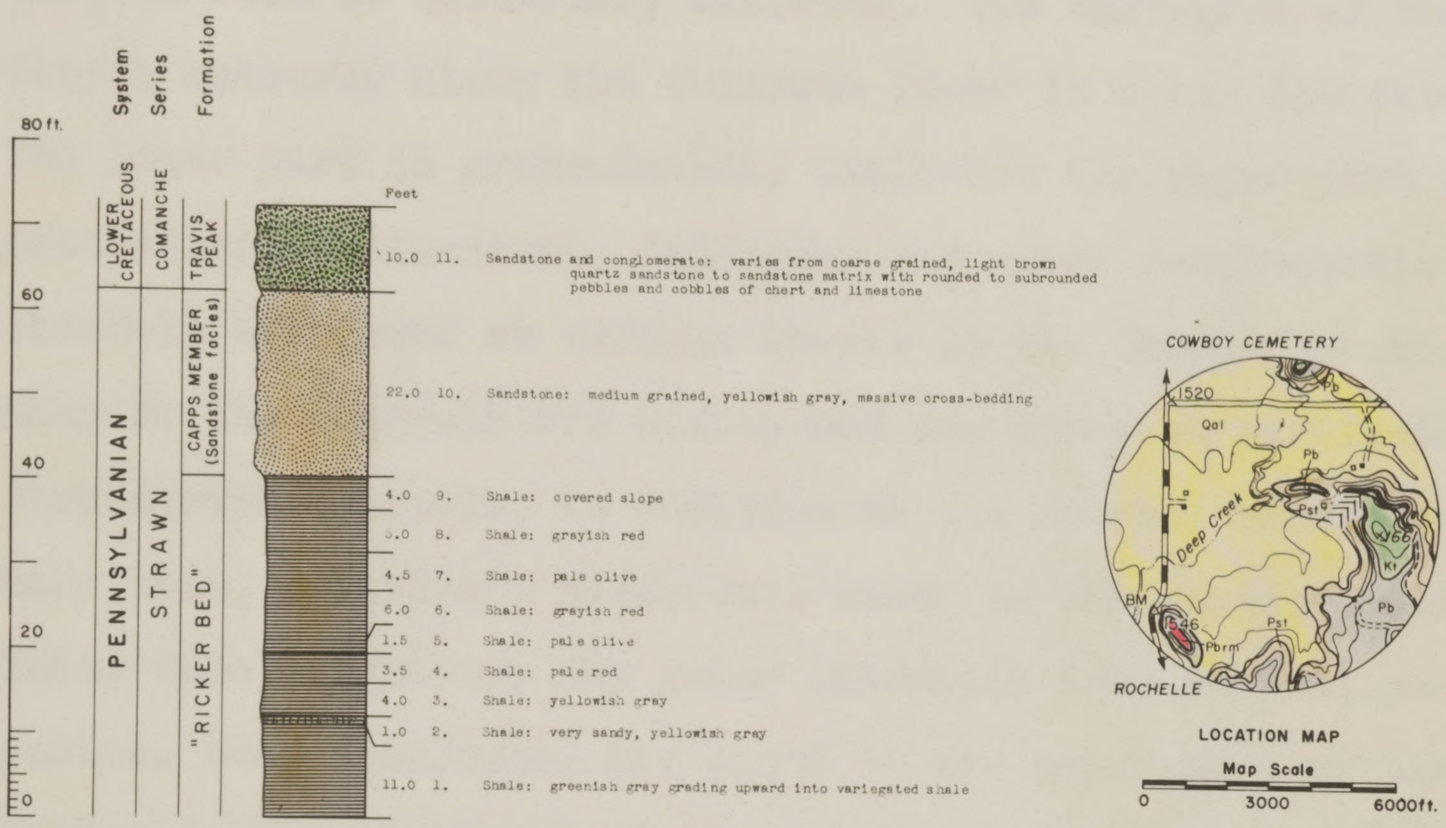


Figure 9. - Section of part of Strawn series ("Ricker Bed" and Capps member) and Travis Peak formation 4 miles southwest of Placid, McCulloch County, Texas.

Canyon Series

The Canyon series is exposed in the western half of the Mercury Quadrangle except where covered by Lower Cretaceous rock or Quaternary alluvium. The thickness of the Canyon measured along the Colorado River is about 650 feet. The lower part is predominantly shale and the upper part is predominantly limestone. Sandstone and chert conglomerate channels are found at various levels in the Canyon series. Many of the channels are widespread and occur at particular stratigraphic levels. In addition to the channel sandstones, many thin, persistent sandstones occur in the Canyon sequence. These thin sandstones may grade laterally into channel deposits. Reef limestones are found in the upper part of the Canyon in the northwest corner of the quadrangle. Several periods of reef growth are interpreted because the limestones which thicken at the expense of shales appear to be superimposed one on top of the other. The Canyon overlaps the Strawn along the northwest margin of the Llano uplift. South of Rochelle the basal beds of the Canyon rest on the Big Saline formation. South of Brady, the Adams Branch formation overlaps the Brownwood shale and overlies the Big Saline formation. This overlap, although known south of the quadrangle, is not so evident on the quadrangle. The strike of the Canyon formations is N 20° E; the average dip, 50 to 75 feet per mile west-northwest (Plate 2).

Nomenclature used in this report is shown in Figures 5 and 10. Major changes here proposed are: 1) the elevation of former member names to formational rank, and 2) the elimination of the Brazos River valley names Whitt, Graford, Brad, Caddo Creek, and Graham, which have little meaning in the Colorado River valley. Details of other proposed changes can be found under the respective headings which follow.

Brownwood shale. - Drake (1893, pp. 387, 389) named the Brownwood shale from exposures near Brownwood, Texas. The history of its classification is shown in Figures 5 and 11. In this report the Brownwood shale includes all beds between the top of the Capps limestone (or its sandstone equivalent) and the base of the Adams Branch limestone. Near Rochelle, Texas, the base of the Brownwood is placed at the bottom of the Rochelle conglomerate. The Rochelle conglomerate (Tarr, 1890, p. 205) and Rough Mountain conglomerate (Plummer 1950, p. 95) are considered as members of the Brownwood shale.

The outcrop of the Brownwood shale occupies a 1- to 2-mile band across the quadrangle from north to south between Deep Creek and the escarpment formed by the Adams Branch limestone. The upper part is well exposed on steep slopes below the Adams Branch limestone; the lower part is covered by alluvium associated with Deep Creek valley. Because of the alluvium cover, no complete measured sections of the Brownwood were obtained. Data from wells drilled west of the Adams Branch escarpment show the following thicknesses of the Brownwood shale:

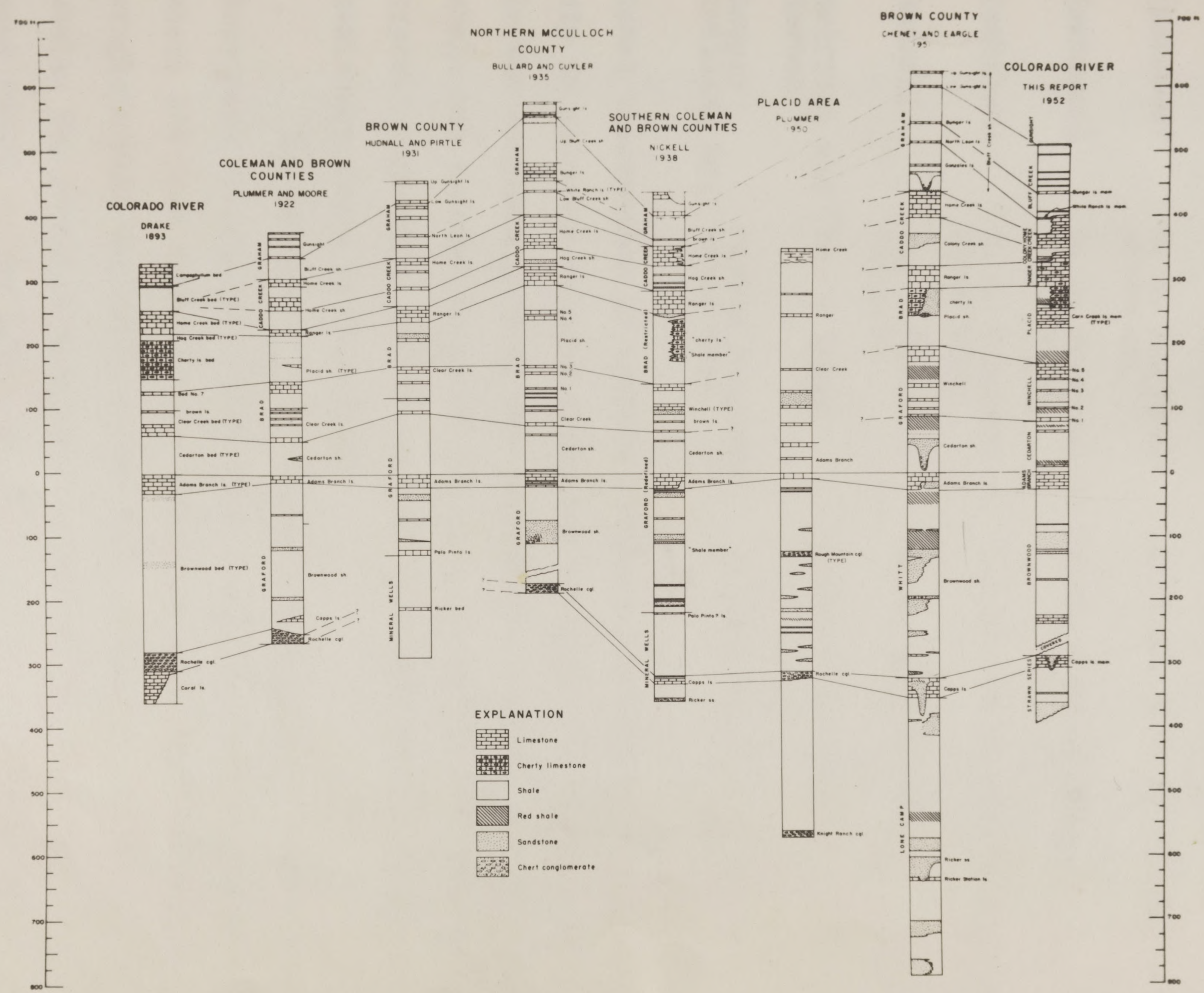


Figure 10. - History of the correlation of the Canyon series in the Colorado River valley, 1893 to 1952.

Driller	Farm	Location	Thickness of Brownwood Shale
Slusher	No. 1 Townsend	1 mi. W of Mercury	267 ft.
(unknown)	D. S. Pumphrey water well	1.75 mi. S SW of Mercury .	261
(unknown)	D. S. Pumphrey water well	3 mi. N NW of Placid . . .	328
(unknown)	D. S. Pumphrey water well	1.5 mi. NW of Placid . . .	283
Russell	No. 1 Parker Pumphrey	2 mi. W of Placid	280
Griffith and Norton	No. 1 Yates	2 mi. SW of Placid	329
Sawyer Drilling Co.	Parker Pumphrey water well	5.5 mi. SW of Placid . . .	293

Total thicknesses of surface sections obtained by projection of dip in alluvium covered areas are close to the above figures. In the southern part of the quadrangle, however, the Brownwood shale has thinned to about 200 feet. Aerial photographs showing typical vegetation and topography developed on the Brownwood shale are found in Figure 11.

Two prominent beds of chert conglomerate occur in the Brownwood shale, one at the base (Rochelle conglomerate) and one about 120 feet from the top (Rough Mountain conglomerate). These conglomerates are assigned the rank of members in the Brownwood shale. The Rochelle conglomerate member has been described in some detail by Bay (1932, pp. 175-181) and Plummer (1950, p. 93, 94) and the Rough Mountain conglomerate member by Plummer (1950, p. 95). These conglomerates are essentially the same in mineralogical composition, consisting of various types of angular chert pebbles in a quartz sand matrix. A distinguishing

Figure 11. - Stereogram of Brownwood, Adams Branch, Cedarton, and Winchell formations near Mercury, McCulloch County, Texas. Pb indicates Brownwood shale; Pa, Adams Branch limestone; Pc, Cedarton shale; Pw, Winchell formation; and Qal, Quaternary alluvium.

feature of these as well as other Pennsylvanian chert conglomerates in the Colorado River valley is the presence of green chert pebbles.

The Rochelle conglomerate member can be traced along its outcrop from Onion Creek ($4\frac{1}{2}$ miles southwest of Rochelle) to a point 2 miles northwest of Sellman, a distance of about 9 miles. The maximum thickness is 18 feet (Plummer, 1950, p. 94) south of the Mercury Quadrangle. The thickness of the member at the southern edge of the quadrangle is 8 feet, thinning to the north where it changes laterally into a cross-bedded sandstone.

The Rough Mountain conglomerate member is exposed along the Rochelle-Cowboy road 0.5 mile south of the quadrangle for a distance of 2.5 miles north to a tank at the base of the Adams Branch escarpment. At its northern outcrop, the member changes laterally into a sandstone which can be traced north a distance of 3.5 miles to the farm road east of Placid. The Rough Mountain conglomerate differs slightly from the Rochelle conglomerate because it contains smaller pebbles and fewer green chert pebbles. The maximum thickness of the conglomerate is 20 feet at the type locality on Rough Mountain (bench mark 1546 feet on Rochelle-Cowboy Road 1.5 miles north of south edge of Mercury Quadrangle).

Representative outcrop sections of the Brownwood shale are given in Figures 18, 19, 20, 21, and 22. The greater part of the Brownwood consists of gray to olive shale. Although not a constant feature, red shale about 25 feet thick is found about 50 feet below the top of the Brownwood. Data from wells drilled west of the Brownwood outcrop indicate that this red shale interval is perhaps more constant than at the outcrop. North of the Colorado River a 25-foot sandstone bed occurs about 70 feet below tha top of the Brownwood; it thins rapidly to the south and is either absent or represented by thin beds of sandstone in the vicinity of Mercury. A thin limestone bed (Unit 23 of Figure 20) which has been correlated with a fusulinid limestone near Brownwood (Nickell, 1938, p. 102) is found only north of the river. This limestone contains no fusulinids in the Mercury Quadrangle. A limestone bed containing Triticites (Unit 7, Figure 21) can be traced north from Mercury into southern Brown County. Exposures of the lower part of the Brownwood have very few distinctive beds which can be traced for any distance. The yellow siltstone 40-50 feet above the base of the Brownwood (Unit 8, Figure 18) can be traced west of Deep Creek from the latitude of Placid to Mercury.

A wide variety of megafossils including bryozoans, brachiopods, crinoids, corals, trilobites, pelecypods, and gastropods are common at various levels in the Brownwood shale.

Fusulinids have been found only in the limestone 107 feet below the Adams Branch limestone (Unit 7, Figure 21). Fossils from the Brownwood in the Mercury Quadrangle are listed in Table 1.

Strawn-Canyon boundary. - To determine the position of the Strawn-Canyon boundary across the Mercury Quadrangle, one must solve the stratigraphic relationship between the Capps limestone member and the Rochelle conglomerate member. The Capps limestone (considered the top member of the Strawn) can be traced as far south as Mercury. In this region the Capps limestone is replaced by chert conglomerates interpreted as channel deposits of lower Canyon (Brownwood) or upper Strawn (Capps) age. South of the southernmost limestone outcrop (east of Mercury), the Capps is represented by a sandstone at the same stratigraphic level. Near Cowboy Cemetery this sandstone is interpreted to be locally replaced by channel sandstone deposits (Figure 18). The sandstone equivalent of the Capps can be traced along the slopes below the Cretaceous and on isolated hills to the northernmost outcrop of the Rochelle conglomerate member. At this location, (2 miles northwest of Sellman) the cross-bedded sandstone equivalent of the Rochelle is interpreted as replacing the sandstone equivalent of the Capps.

The Rochelle conglomerate member is considered a channel deposit of Canyon (Brownwood) age because of its stratigraphic relationships and similarity to other channel deposits higher in the Canyon series, although the Rochelle conglomerate is perhaps unique in its length of outcrop (9 miles). Downdip in water wells at Rochelle, Texas, the conglomerate is mainly sandstone (Plummer, 1950, p. 94). Wells drilled 5 miles northwest of the Rochelle outcrop (Corn Creek Hills) did not encounter conglomerate or sandstone at this stratigraphic level. The Rochelle is similar in mineralogy, texture, and thickness to other chert conglomerates of the Canyon whose channel-like characteristics are better known (for example, channels described under Cedarton, Winchell, and Placid formations). Thin limestone beds adjacent to channel deposits of the upper Canyon serve as guides for measuring the extent of channelling. In contrast, the Rochelle conglomerate member rests on homogeneous shale making its relationship to underlying beds less obvious.

Plummer (1950, p. 88) reported a Strawn assemblage of fossils from the shale below the Rochelle at a locality 2 miles south of the Mercury Quadrangle and 3 miles east of Rochelle, Texas (See Table 1). Among the fossils found at this locality were _Fusulina rickerensis_ Thompson and _Mesolobus mesolobus_ (Norwood and Pratten). The next highest occurrence of fossils is in the Brownwood shale at Rugged Mountain (west of Rochelle-Cowboy road and 1 mile north of south edge of Mercury Quadrangle). The beds in which the fossils occur are estimated to be about 60 feet above the Rochelle conglomerate. The fossils at Rugged Mountain are long-ranging forms and not valuable as age indicators. These fossils are listed in Table 1.

Reasons for placing the Strawn-Canyon boundary in the Mercury Quadrangle at the top of the Capps limestone (or its sandstone equivalent) and at the base of the Rochelle conglomerate are summarized below:

1. The Capps limestone is the highest known occurrence of Strawn fusulinids. The lowest fusulinids in the Brownwood shale (107 feet from top) are of Canyon age.
2. The Capps limestone changes into sandstone southward. This sandstone is replaced by the Rochelle conglomerate, interpreted as a channel deposit.
3. The shale below the Rochelle conglomerate is established as Strawn because Strawn fossils are present.
4. The Rochelle conglomerate is interpreted as a channel deposit younger than the Capps limestone. This conglomerate is believed to mark the beginning of Canyon sedimentation in the Rochelle area.

Adams Branch limestone. - The Adams Branch limestone was named by Drake (1893, pp. 387, 391) from exposures on Adams Branch west of Brownwood, Texas. A graphic history of its classification is shown in Figure 10. The Adams Branch limestone in this report is assigned the rank of a formation.

The Adams Branch limestone is exposed across the central part of the Mercury Quadrangle from north to south forming a narrow outcrop the width of which rarely exceeds one mile. North of Placid, this formation makes a conspicuous escarpment facing Deep Creek valley (Figure 11). South of Placid, the escarpment is formed by Winchell or Cretaceous beds and the Adams Branch limestone crops out as a lower secondary bench. In the Mercury Quadrangle, the thickness of this formation ranges from 9 to 27 feet along its outcrop. Data from wells drilled in the western part of the Quadrangle indicate a rather uniform 20- to 25-foot thickness of the limestone. The thickest measured section of Adams Branch limestone (27 feet) is located 2 miles south of Mercury. From this point south, the limestone thins to a minimum of 9 feet south of Placid. The average thickness south of Placid is 12 feet.

Typical sections of the Adams Branch limestone in the Mercury Quadrangle are shown in Figures 19, 21, 22, 23, and 24. The characteristic thin, wavy beds of the formation are apparent only in exposures which have been deeply weathered. Wherever the limestone is relatively unweathered, it forms a massive unit in which bedding planes are obscure.

Fossils are abundant and varied in the Adams Branch limestone. Most of the megafossils can be found in a 4- to 5-foot shale bed below the massive portion of the limestone and above the 1-foot limestone bed at the base. The top beds of the formation contain fusulinids. Fossils found in the Adams Branch limestone in the quadrangle are listed in Table 1.

<u>Cedarton shale</u>. - The type locality of the Cedarton shale (Drake, 1893, pp. 387, 391) is near the village of Cedarton, central Brown County. In the Mercury Quadrangle the Cedarton includes the shale interval between the Adams Branch limestone

and the basal limestone bed of the Winchell formation (Winchell limestone No. 1 of this report).

From Placid to the Colorado River, the Cedarton shale forms a steep slope below the Winchell cuesta and the 1- to 2-mile flat west of the Adams Branch escarpment. Aerial photographs (Figure 11) illustrate the topography and vegetation normally developed on the Cedarton north of Placid. South of Placid, the Cedarton outcrop is incorporated in the steep slope below the cuesta-forming Winchell limestone beds. The Cedarton reaches its maximum thickness (80.5 feet) in the quadrangle at outcrops along the Colorado River, and thins southward to a minimum of 29.3 feet at Placid. South of Placid the shale thickens to 45 feet at the south edge of the quadrangle. Exposures of Cedarton can be found west of its normal outcrop as inliers along Corn Creek.

Sections of the Cedarton shale showing thickness and lithology are given in Figures 19, 22, 23, and 24. The greater part of the formation is olive shale, but consistently the upper and lower 3- to 6-feet are graying red shales. Thin limestone beds and coquinas occur in the lower 15 feet of the formation. These coquinas contain many well preserved megafossils rivaling the rich collections in the Brownwood shale (see Table 1.).

Thick, lenticular, cross-bedded sandstones interpreted as channel deposits occur at two horizons in the Cedarton shale. At a locality 3 miles northeast of Placid on the escarpment facing Deep Creek, a 20-foot sandstone near the base of the Cedarton completely replaces the Adams Branch limestone. Where the sandstone is thickest, the basal beds are conglomerate, containing the same types of chert pebbles found in the Rochelle and Rough Mountain conglomerates. The Cedarton conglomerate differs from the Rochelle and Rough Mountain conglomerates in having smaller sized pebbles (average 0.5 inch) and fewer green chert pebbles. Associated with this occurrence are similar sandstone beds found on top of the Adams Branch limestone at two inliers located 0.2 mile west and 1.0 mile west southwest. This sandstone is interpreted as a part of a narrow channel deposit trending approximately east-west. At the outcrop farthest east, the channel deposits are thicker, contain conglomerate at the base, and replace the underlying Adams Branch limestone. Sandstone lenses also interpreted as channel deposits occur at a higher level in the Cedarton. At localities 3 to 4 miles south of Placid, massive sandstone lenses are present in the upper part of the Cedarton. The tops of these beds are 10 to 15 feet below the top of the Cedarton and extend downward in the Cedarton shale 10 to 20 feet at places of maximum development. No lineation of these channel deposits can be inferred yet because of the limited number of outcrops.

The Cedarton shale probably contains the widest variety of Canyon fossils in the Mercury Quadrangle. The lower 20 feet of the formation is particularly rich in fossils, both in the shale and in the thin limestone beds. A representative but not exhaustive list of Cedarton fossils is found in Table 1.

Winchell formation. - The history of beds classified in this report as the Winchell formation is shown in Figure 11. Nickell's definition of the "Winchell member of the Graford formation" (1938, p. 105) is as follows:

> As herein described, the lowest limestone of the member is taken to be that one which caps the escarpment west of Winchell, and the top is taken as the limestone bed that forms the broad bench about 1 mile northwest of Winchell, on which the United States Geological Survey bench mark is set at an altitude of 1417 feet. (This altitude is marked "1416" on the 1950 edition of the Mercury Quadrangle.)

In the present report the Winchell member of Nickell is raised to formational rank. Nickell numbered the limestone beds of the Winchell 1 through 4 in ascending order. The numbering system proposed by Nickell is followed here except that Nickell's limestone No. 4 is called No. 4 and No. 5. South of the Colorado River the basal 2 feet of Nickell's limestone No. 4 is separated from the top limestone of the Winchell by a shale interval which may be 12 feet thick. The 2- to 2.5-foot limestone below this shale is called limestone No. 4 and the top limestone bed of the Winchell above this shale is called limestone No. 5.

The alternating thin limestone and thick shale beds of the Winchell formation make a 1- to 3-mile wide outcrop across the quadrangle. At its southern outcrop, the top of the Winchell formation is covered by Cretaceous beds, the lower beds being exposed in the escarpment east of the Cretaceous outcrop. Each of the Winchell limestone beds may form a cuesta, but limestone No. 1 (at the base) and limestone No. 5 (at the top) form the most conspicuous cuestas of the formation. Live oak trees grow on the limestone beds, in contrast to mesquite trees or grass on the shale. As a result, each thin limestone makes a line of live oak trees which can be traced in the field or on aerial photographs (Figures 11, 12, and 13).

At the type section 0.75 mile north of Winchell, the formation is 72.5 feet thick (Nickell, 1938, pp. 106, 107). Downdip to the west, the Winchell formation is thicker due to an expansion of both limestone and shale intervals (Figure 20.). Kelley, No. 1 Harris-McDaniel, an oil test drilled 3 miles west northwest of Winchell, Texas, encountered 105 feet of Winchell formation including 57 feet of limestone. Wells drilled west of the outcrop of the Winchell elsewhere in the Mercury Quadrangle show a comparable increase in total thickness and percent of limestone. The Winchell formation also thickens southward along the strike to a maximum of about 100 feet, west of Mercury. South of Mercury the formation thins rapidly.

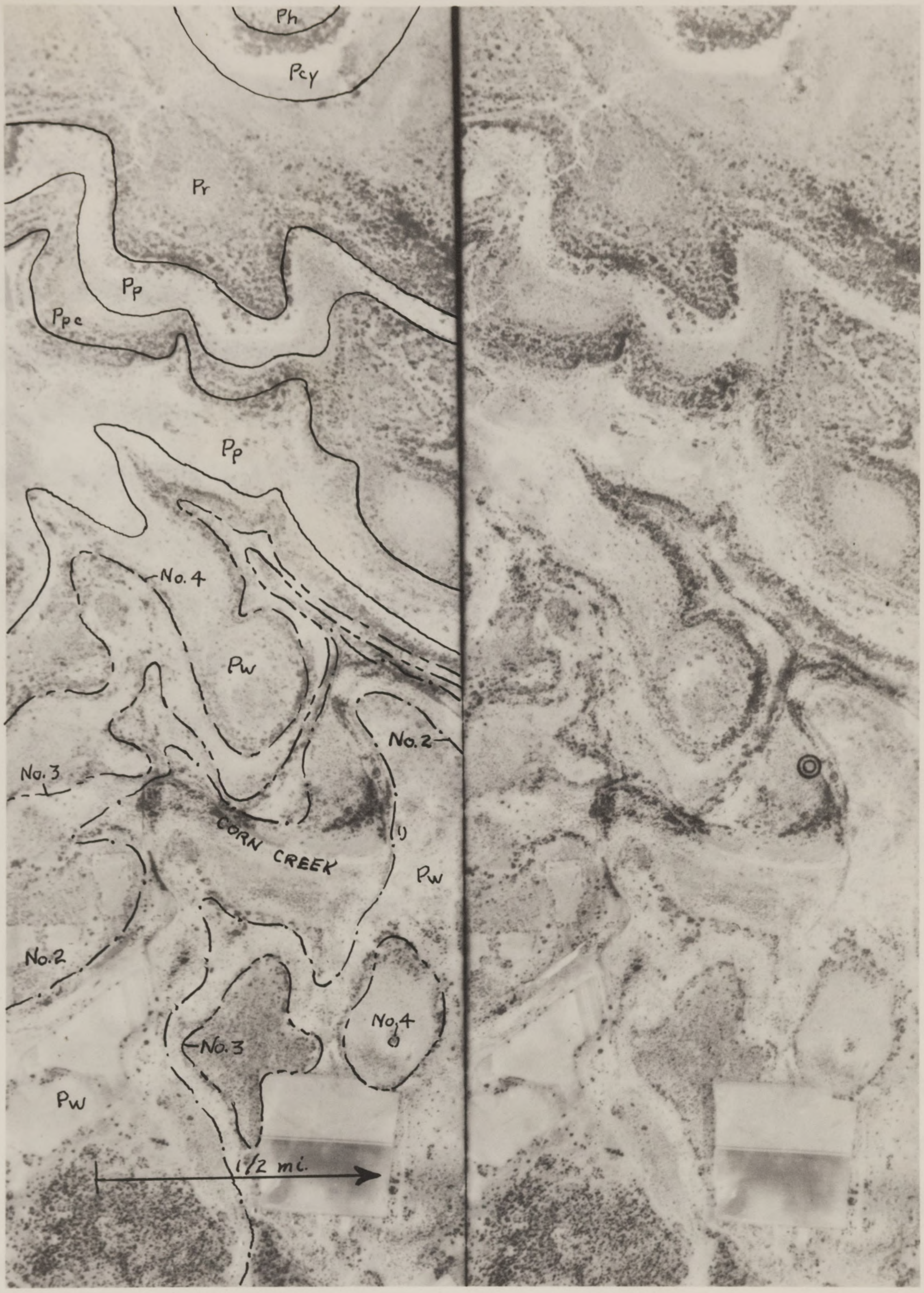


Figure 12. - Stereogram of Winchell, Placid, Ranger, Colony Creek, and Home Creek formations along Corn Creek, west of Mercury, McCulloch County, Texas. Pw indicates Winchell formation with limestones No. 2, 3, 4, and 5; Pp, Placid shale; Ppc, Corn Creek limestone member of Placid shale; Pr, Ranger limestone; Pcy, Colony Creek shale; and Ph, Home Creek limestone.

Representative sections of the Winchell formation showing types of rock and thicknesses are shown in Figures 19, 22, 23, 24, 25, 26, and 27. Limestone beds of the Winchell formation are recognizable by stratigraphic position, thickness, peculiarities of weathering, color, and topographic expression. Intervening shale (mostly covered) and sandstone beds are referred stratigraphically to the more prominent limestone beds. Criteria for field identification of the limestone beds of the Winchell formation are as follows:

1. Limestone No. 1 (lower Clear Creek of Bullard and Cuyler) forms cuesta; overlies thick shale (Cedarton); is 5 to 6 feet thick; thickens south of Placid to 9 feet; is mesograined, yellowish gray, with 3- to 6-inch beds.
2. Limestone No. 2 (upper Clear Creek of Bullard and Cuyler) is 1.5 to 3.0 feet thick; mesograined, dark yellowish brown, with 1 or 2 beds; weathers moderate yellowish brown; overlain or locally replaced by sandstone; most uniform bed of formation; can be traced across entire quadrangle and north of quadrangle 25 miles.
3. Limestone No. 3 (Placid No. 1 of Bullard and Cuyler) is 1.0 to 1.5 feet thick; mesograined, light olive gray to pale yellowish brown; can not be traced with certainty south of a point 1.5 miles north of Placid.

4. Limestone No. 4 (Placid No. 2 of Bullard and Cuyler) is 2 to 3 feet thick; mesograined, light olive gray, with 2- to 6-inch beds; weathers with many large dark yellowish orange splotches (not peculiar to this limestone but splotches are more numerous on this bed); merges into limestone No. 5 at Colorado River.
5. Limestone No. 5 (Placid No. 3 of Bullard and Cuyler) is 8 to 22 feet thick; forms cuesta; mesograined, light olive gray, with 3- to 6-inch beds; has wavy bedding planes; thickens at Colorado River.

Sandstone in the Winchell formation is almost completely confined to the interval between limestone No. 2 and No. 3. At two places (1.5 miles west of Winchell and 4 miles south of Placid) sandstone beds have been observed between limestone No. 3 and No. 4. The sandstones between limestone No. 2 and No. 3 at many places extend downward replacing No. 2 and resting on No. 1. These sandstone beds are interpreted as channel sediments deposited after removal of limestone No. 2. No conglomerate has been found in the Winchell formation. Extensive channel sandstone deposits occur above limestone No. 2 near the mouth of Corn Creek and at Placid, Texas. Figure 13 shows the outcrop of a part of a system of channel deposits which have replaced limestone No. 2. East of Corn Creek there is a well defined east-west lineation of the channel sandstones. West of Corn

Figure 13. - Stereogram showing channel sandstone which replaces Winchell limestone No. 2, 2.5 miles northwest of Mercury, McCulloch County, Texas. Red dots indicate outcrop of channel sandstone; Pc, Cedarton shale; Pw, Winchell formation; Pp, Placid shale; Ppc, Corn Creek member of Placid shale; and Pr, Ranger limestone.

Creek, the sandstone is present along the west bank extending north almost to the Colorado River.

Megafossils are rare and fusulinids have not been found in Winchell outcrops in the Mercury Quadrangle. A coral colony made up of numerous specimens of Campophyllum occurs at the level of limestone No. 5 at a locality 1.7 miles northwest of Mercury at the top of an outlier (western peak) of upper Winchell limestones. Table 1 lists those fossils which have been found in the Winchell formation.

Placid shale. - Named for the town of Placid, Texas (southeast west Mercury Quadrangle), the Placid shale (Plummer and Moore, 1922, p. 110) includes beds between the top of the Clear Creek limestone (top of limestone No. 2 of Winchell formation) and the base of the Ranger limestone. Bullard and Cuyler (1935, p. 207) closely followed the boundaries of Plummer and Moore, but numbered the Placid limestone beds 1 to 5 from oldest to youngest. Nickell (1938, p. 111) included the lower part of the Placid shale in the Winchell member and called that portion between the top of the Winchell and base of Ranger the "shale member." He placed Drake's "Cherty limestone" (1893, pp. 387, 395) within the unnamed shale member. In southern Brown County, Cheney and Eargle mapped the limestone occurring about 35 feet below the Ranger as basal Ranger (Corn Creek member of this report), and included the "Cherty limestone" which occurs above this limestone in the Placid shale. The history of nomenclature and various interpretations of the stratigraphy of the Placid shale are graphically shown in Figure 10.

The Placid shale (restricted) of this report applies to beds between the top of the Winchell and the base of the Ranger limestone (equals Nickell's "shale member"). The base of the Ranger in the Placid area is the base of the limestone capping the outlier about 1 mile northwest of Placid (on top of hill just west of U. S. Highway 283). North of the Colorado River the base of the Ranger occurs at the bottom of the limestone on top of the highest hill 1.5 miles northwest of Winchell (just west of secondary road between Winchell and Brookesmith). The limestone which forms a wide bench about 35 feet below the Ranger limestone is herein designated the Corn Creek limestone (new name) member of the Placid shale.

The best exposures of the Placid shale are below the Ranger escarpment west of Corn Creek from Beef Pasture Tank to Chamberlain Creek. It is suggested that this area be established as an alternative type area for the Placid shale. Sections showing thickness and lithology of the Placid shale can be found in Figures 25, 26, 27, 28, 29, and 30.

The Corn Creek member (Placid No. 4 and 5 of Bullard and Cuyler) of the Placid shale is named from typical exposures west of Corn Creek on the W. M. White and Co. Ranch. The type section of this member (located at Beef Pasture Tank) is shown in Figure 30. Other places where the member is typically developed are as follows:

1. Above Big Tank, 1 mile northwest of Beef Pasture Tank (Figure 26);
2. On the Winchell-Brookesmith road 0.8 mile north of U. S. Geological Survey bench mark 1416 feet (1.5 mile airline distance northwest of Winchell), Figure 29;
3. 1.8 mile north of U. S. Geological Survey bench mark 1416 feet on Winchell-Brookesmith road, about 0.1 mile due east of intersection of north-south road and east-west road (just north of Mercury Quadrangle).

In the Mercury Quadrangle the member varies in thickness from 19 to 27 feet. It consists of two limestone beds separated by a 4- to 7-foot shale interval. The member can be traced from the Cretaceous cover southwest of Placid north a distance of 20 miles to Brookesmith in southern Brown County. The limestone thins from the Mercury Quadrangle north, and its northernmost outcrop is terminated abruptly by channel sandstone deposits (Eargle, February 1952, personal communication).

The shale interval below the Corn Creek member is 37 to 75 feet thick. West of Winchell and in the vicinity of Big Tank on the W. N. White and Co. Ranch, the lower 10 to 20 feet is red shale. From Beef Pasture Tank south to the head of Bull Branch on the D. S. Pumphrey Ranch, 1 or 2 thin sandstones are present 10 to 20 feet from the base of the shale.

The interval above the Corn Creek member may be shale or limestone. The relationship between these facies has led to much confusion in the correlation of these beds. Drake (1893, pp. 387, 395) called the limestone facies the "Cherty limestone bed." From his descriptions it appears that he included the overlying Ranger limestone in the "Cherty limestone bed." Nickell (1938, pp. 111-114) correctly placed the "Cherty limestone" below the Ranger, stating that it was equivalent to the limestone herein called the Corn Creek member to the north. Cheney (1948) placed the top of the Ranger at the top of the "Cherty limestone" of Nickell.

In this report, the "Cherty limestone" is interpreted as a reef facies of the shale between the Corn Creek limestone and the Ranger limestone.

The shale facies is exposed over most of the Mercury Quadrangle. It is normally 30 to 40 feet thick, but south of Beef Pasture Tank it thins rapidly to 9 feet at the head of Bull Branch. A persistent sandstone bed is present 6 to 10 feet above the Corn Creek member from the Winchell area south to Big Tank.

Exposures of the limestone facies of the upper Placid shale are found on Tom Dean Creek 0.25 mile from its mouth, on both sides of the Colorado River between the mouths of Homes Creek and McDowell Creek, and along Homes Creek from the mouth of Boggy Creek upstream to the mouth of Mukewater Creek (north of the northwest corner of the Mercury Quadrangle). Along the Colorado River, elongate reef-like limestone masses project above the Corn Creek member into the overlying shale. Downdip at the Homes Creek locality the entire interval between the Corn Creek and Ranger is cherty limestone. At the locality on Tom Dean Creek, cherty limestone is found below the Ranger. The lithology of the cherty limestone at Tom Dean Creek is illustrated in Figures 14 and 15. Convincing evidence of the reef-like structure of the cherty limestone facies of the Placid is shown in Figure 16 where a massive bed "drapes" over the upturned edges of strata the steep east dips of which are interpreted as initial dips associated with underlying reefs. Two miles west of the Mercury Quadrangle, about 2 miles from the mouth of Cedar Creek, the Corn Creek member and the Ranger limestone are exposed with the interval between them composed of cherty limestone.

At the mouth of McDowell Creek, the reef limestone is locally replaced by a thick cross-bedded chert conglomerate which rests in places on the Corn Creek member. The thickness varies greatly within short distances, reaching a maximum of about 30 feet. The conglomerate forms a narrow outcrop trending

Figure 14. - Reef limestone facies of Placid shale on Tom Dean Creek about 0.25 mile from mouth. White rock is chert and gray rock is limestone.

Figure 15. - Close-up of rocks near hammer in Figure 14. White rock is chert and gray rock is limestone.

Figure 16. - Reef in cherty limestone facies of Placid shale "draping" over beds with steep initial dip. Southward view on Tom Dean Creek, 0.25 mile from mouth.

east-west. The contact between the reef limestone and the conglomerate is sharp and can be seen clearly in three dimensions. Angular fragments of the underlying Corn Creek member are present in the lower beds of the conglomerate where the two are in contact. This conglomerate has been studied by Bay (1932, p. 182) who stated that it has a composition and texture similar to the Rochelle conglomerate. Figure 17 shows boulders of this conglomerate found near the mouth of McDowell Creek.

Because of the narrow east-west lineation of the outcrop the sharp unconformable contact with the reef limestone, the presence of fragments of the Corn Creek member incorporated in the base of the conglomerate, the composition and grain size, and the cross-bedding, it is concluded that the conglomerate represents the deposits of a narrow channel which has replaced reef limestone above the Corn Creek member.

Ranger limestone. - The Ranger limestone was named for the town of Ranger, Eastland County, Texas. Plummer and Moore (1922, p. 110) applied the name for the first time in the Mercury Quadrangle to beds which they correlated with Drake's "Cherty limestone bed" (1893, pp. 387, 395). Nickell (1938, pp. 108-110) stated that the type Home Creek of Drake is correlative with the Ranger limestone. Cheney (1948) correlated the Ranger limestone with Nickell's "cherty limestone" and the Home Creek limestone with Nickell's Ranger limestone. More recently Cheney and Eargle (1951) mapped the base of the

Figure 17. - Boulders of channel conglomerate above Corn Creek member of Placid shale, showing cross-bedding and chert pebbles.

Ranger at the base of the Corn Creek member of this report, and the top of the Ranger at the base of the Colony Creek shale.

The Ranger limestone of this report compared with the interpretations of Drake, Plummer and Moore, Nickell, Cheney, and Cheney and Eargle follows:

1. Drake's (1893) top of the Home Creek limestone correlates with the top of the Ranger (this report); his type Home Creek limestone is the base of the Ranger of this report. A discussion of the correlation of Drake's Home Creek at the type area can be found in Nickell (1938, pp. 108-111, 114-118) and under the description of the Home Creek limestone in this report.
2. Plummer and Moore's (1922) top of Ranger is the same as in this report; their base correlates with the present interpretation where the "Cherty limestone" is absent. According to Plummer and Moore, Drake's "Cherty limestone bed" is equivalent to their Ranger limestone. The cherty limestone is now considered to be below the Ranger.
3. Nickell's (1938) top and base of the Ranger agrees with the present interpretation. Nickell stated that the type Home Creek (Drake) is the Ranger limestone farther north.
4. Cheney's (1948) top of the Home Creek limestone is the top of the Ranger of this report; his base

of the Home Creek limestone becomes the base of the Ranger in the present interpretation.

5. Cheney and Eargle's (1951) top of Ranger is the same as described herein; the top of their cherty member (or base of their limestone above Corn Creek member) correlates with the base of the Ranger of the present report.

A graphic history of the nomenclature and correlation of the Ranger is shown in Figure 10.

The Ranger limestone forms a high escarpment west of U. S. Highway 283 in the western part of the quadrangle. The width of the outcrop averages 2 to 3 miles across the area. The back-slope of the Ranger (in most places a dip-slope) is dissected by Cedar, Tom Dean, Homes, and Boggy creeks which expose younger rocks along their valleys. Aerial photographs showing the outcrop of the Ranger limestone are shown in Figures 12 and 13.

Sections showing the thickness and lithology of the Ranger limestone are in Figures 25, 26, 27. 28, 29, 30, and 31. The thickness of the Ranger in the Mercury Quadrangle varies from a maximum of 70 feet on the Colorado River (Nickell, 1938, p. 114) to a minimum of 25 feet at Lost Mountain. The formation thins both to the north and to the south of the Colorado River. Northwest of Winchell the lower part of the Ranger contains a 5-foot shale bed near the base.

South of the Colorado River, thin shale beds are present near the top of the formation.

Although nodular and bedded chert is characteristic of the Ranger limestone, the position of the chert within the formation is not constant. At some places it occurs throughout the limestone (Figure 26), at others, it appears near the base (Figures 25, 28, and 29), or, rarely, it is absent (Figures 30 and 31).

The thickened Ranger limestone north of Boggy Creek and along Homes Creek upstream from the mouth of Boggy Creek is interpreted as reefing of the Ranger limestone. The lithology and the thickness of the Ranger showing its reef-like facies are illustrated in Figure 30. Plane-table mapping north of Boggy Creek indicates that the Ranger limestone thickens at the expense of the overlying Colony Creek shale and at some places may entirely replace this shale interval. Steep dips thought to be initial dips associated with reefs are locally apparent in the Ranger along Boggy Creek. The reefing of the Ranger coincides at least in part with the underlying reef facies of the Placid shale (cherty limestone facies).

Fossils are common in the Ranger limestone but are not varied. At some places fusulinids are abundant in the chert nodules. Fossils reported from the Ranger in the quadrangle are listed in Table 1.

<u>Colony Creek shale</u>. - Cheney (1948, p. 20) proposed the name "Colony Creek shale" for the beds between the Ranger limestone and the Home Creek limestone in order to replace the misapplied "Hog Creek shale" of previous workers. The Colony Creek shale is named for typical exposures west of Ranger in Eastland County, Texas. The history of the nomenclature of this formation in the Colorado River valley is shown in Figure 10.

The Colony Creek shale crops out as a narrow band below the Home Creek limestone outliers north and south of the Colorado River. The maximum thickness of this formation observed in the Mercury Quadrangle was 23 feet at Lost Mountain (west of Mercury). Along Homes and Boggy Creeks in Coleman County, the Colony Creek shale is thin or absent. Thickening of the underlying Ranger limestone at the expense of the overlying shale has reduced the outcrop of the Colony Creek shale to a narrow bench between the Ranger and Home Creek limestones. The bench, which may possibly represent the Colony Creek shale at its thinnest, is covered by talus. Wherever the Colony Creek shale reaches a thickness of approximately 20 feet, a thin sandstone is present near the base. Near the mouth of Tom Dean Creek, this sandstone is 5 feet thick: at other places in the quadrangle it is 1 to 2 feet thick. Vertebrate bones (probably fish remains) were collected from this sandstone at a tank on Tom Dean Creek 0.9 mile west of McDowell Well.

Fossils other than the vertebrate remains have not been observed in the Colony Creek shale exposed in the Mercury Quadrangle.

Home Creek limestone. - The type area of the "Home Creek bed" is described by Drake (1893, p. 398) as follows:

Along Home Creek, one and a half to two miles above its mouth, the bed is thirty to thirty-five feet thick, the lower twenty-five feet being hard blue rough-surfaced massive limestone.

Nickell (1938, pp. 108-111, 114-118) correlated Drake's type Home Creek with the Ranger limestone to the north, and stated that Drake used the term "Home Creek" north of the type area for the limestone above the type Home Creek limestone. The present work in the Mercury Quadrangle supports the conclusions of Nickell. The beds described as the "Home Creek bed" by Drake along Homes Creek are mapped as Ranger limestone. The thin limestone which occurs above the Ranger limestone is correlated with the Home Creek limestone in recent geologic maps of Brown County. Various interpretations of the boundaries of the Home Creek limestone are graphically illustrated in Figure 10.

Outcrops of the Home Creek limestone occur in the northwestern part of the Mercury Quadrangle along the Colorado River and Homes Creek and on outliers above the Ranger and Colony Creek outcrops.

The Home Creek limestone in the Mercury Quadrangle can be divided into two facies: 1. a limestone-shale facies on the outliers north and south of the Colorado River (Figures 25, 26, and 30); and 2. a reef facies north of the Colorado River and west of Homes Creek (Figure 31). Although outcrops of the limestone-shale facies occur as outliers with no overlying Bluff Creek shale, the thickness of the Home Creek limestone measured west of Winchell (Figure 26) and at Lost Mountain (Figure 25) is thought to be close to the total thickness of the formation. On these outliers the Home Creek is approximately 35 feet thick, and consists of 3 limestones with a 4-foot shale near the base and a 13- to 15-foot shale near the middle of the formation. On Homes Creek (Figure 30) just north of the quadrangle, the thickness of the formation has decreased to 17 feet. The reef facies of the Home Creek limestone (Figure 31) is exposed in high bluffs north of the Colorado River. The upper surface of the formation is irregular, at places projecting 35 to 40 feet upward into the overlying Bluff Creek shale. One mile northwest of the mouth of Homes Creek the top beds of the Home Creek limestone rise above the White Ranch limestone; a short distance west, the interval between the White Ranch limestone and the top of the Home Creek limestone is 35 feet. Dips over these projecting features (here interpreted as reefs) are steeply quaquaversal. The maximum thickness of the Home Creek limestone observed where reefing is present is 50.5 feet (Figure 31).

The coral Campophyllum is characteristically present in the limestone beds of the Home Creek. Although found above and below this level, the abundance of Campophyllum is a useful aid in field identification of the Home Creek limestone.

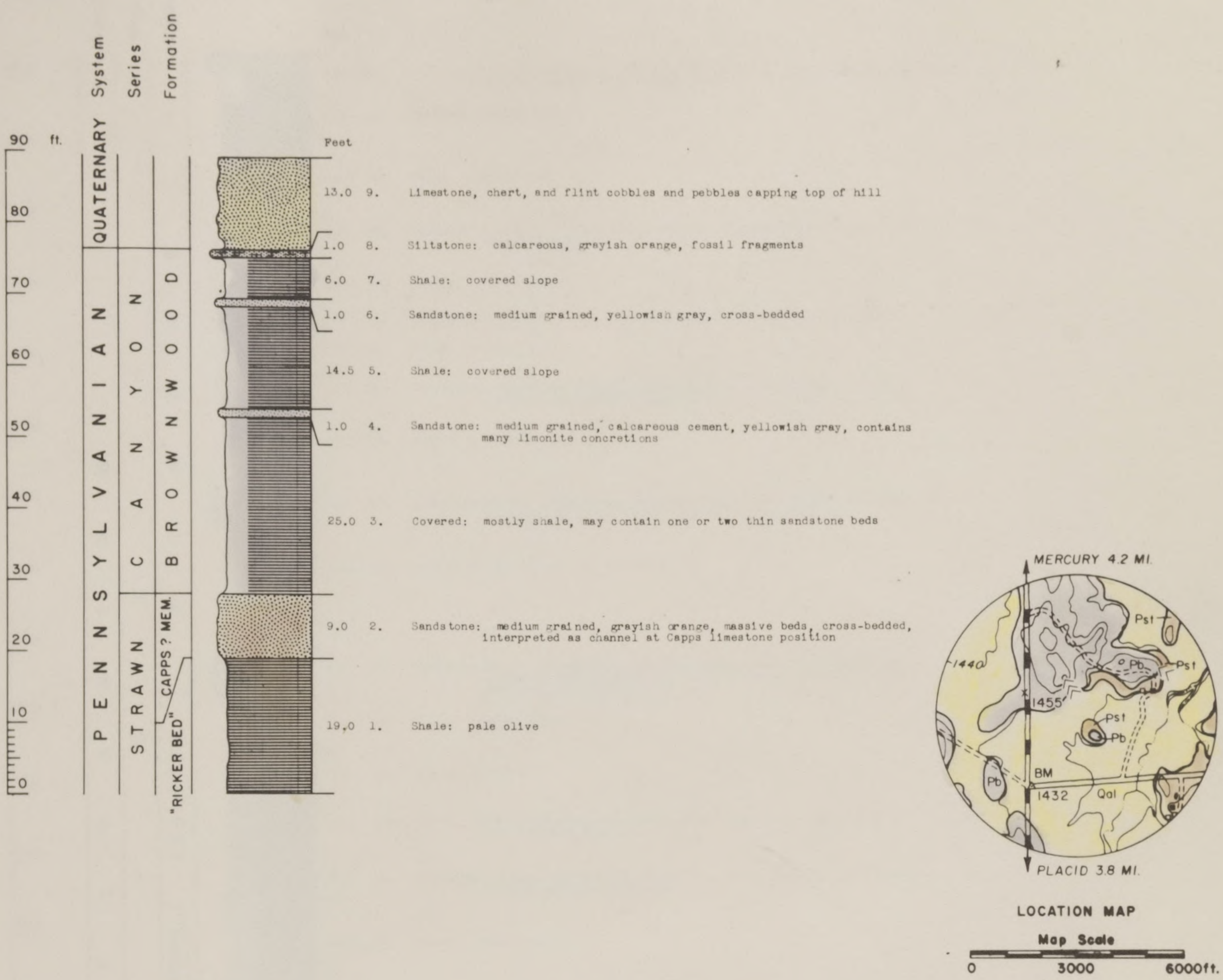


Figure 18. - Section of upper part of Strawn series and lower part of Brownwood shale 4000 feet northwest of Cowboy Cemetery, McCulloch County, Texas.

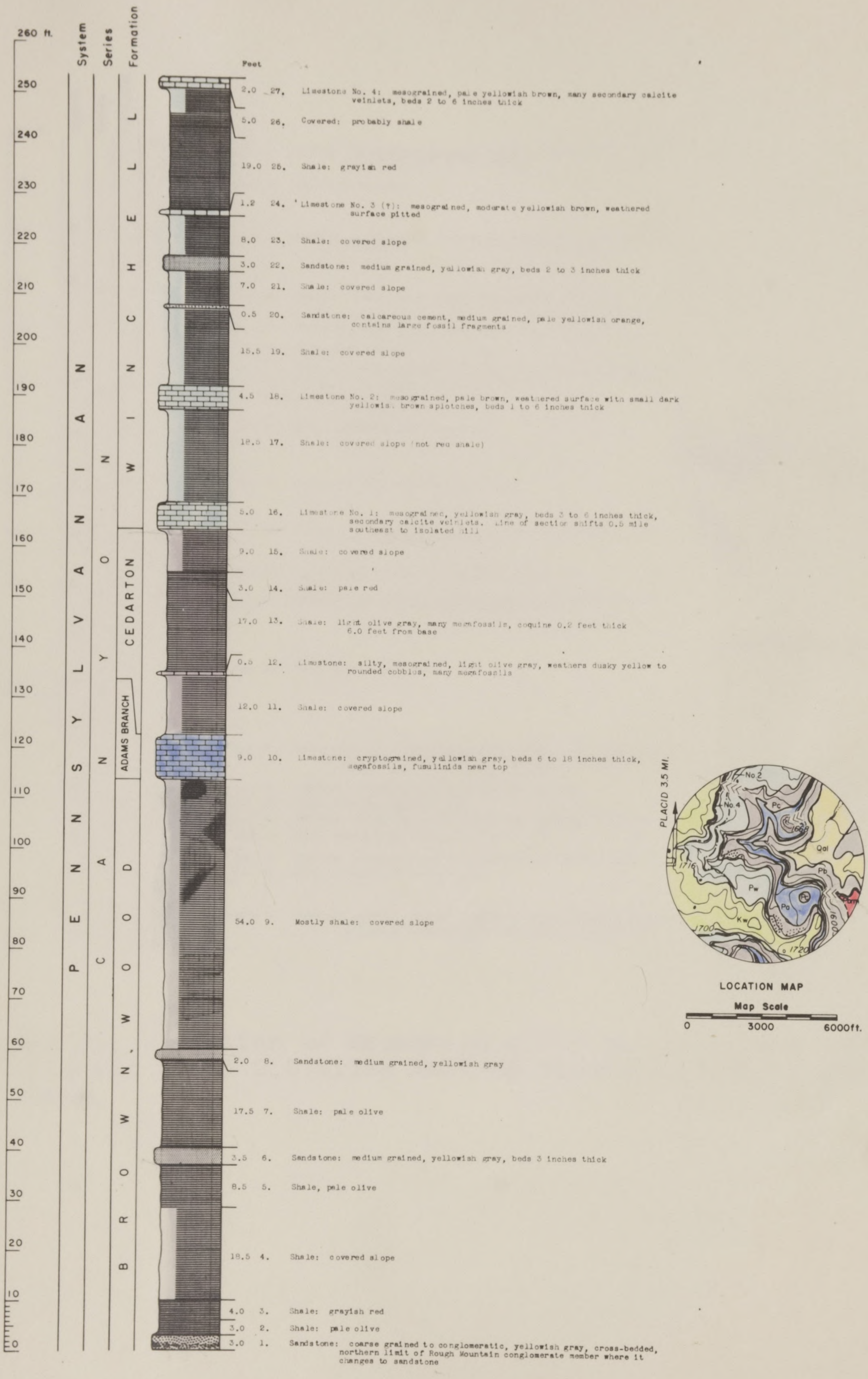


Figure 19. - Section of Brownwood, Adams Branch, Cedarton, and Winchell formations, 3.5 miles south-southeast of Placid, McCulloch County, Texas.

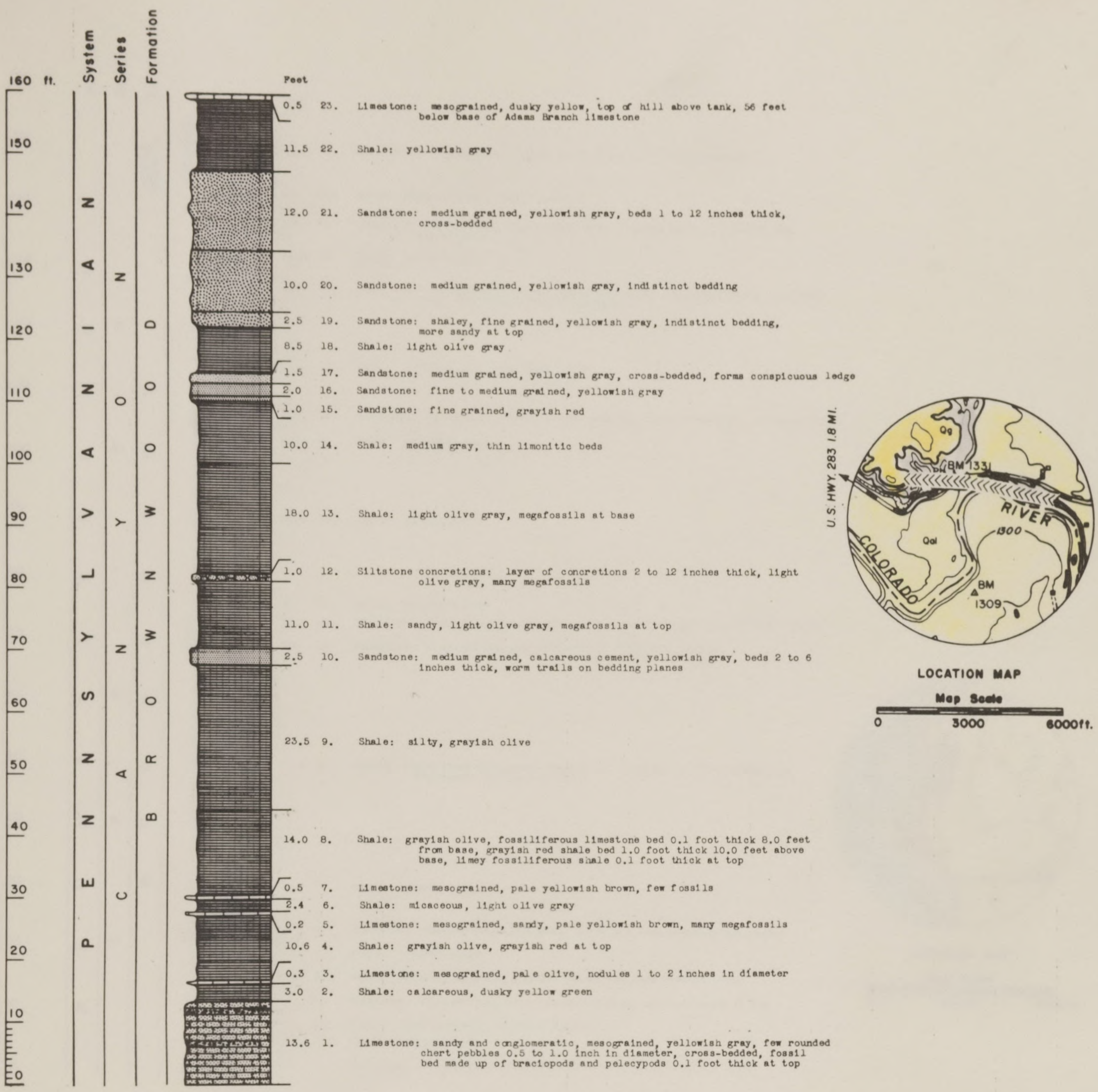


Figure 20. - Section of Brownwood shale on north bank of Colorado River 2.5 miles east of Winchell, Brown County, Texas.

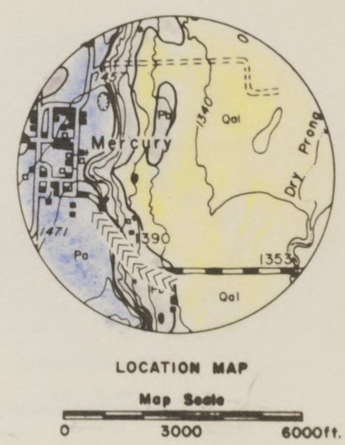


Figure 21. - Section of Brownwood shale and Adams Branch limestone 0.5 mile southeast of Mercury, McCulloch County, Texas.

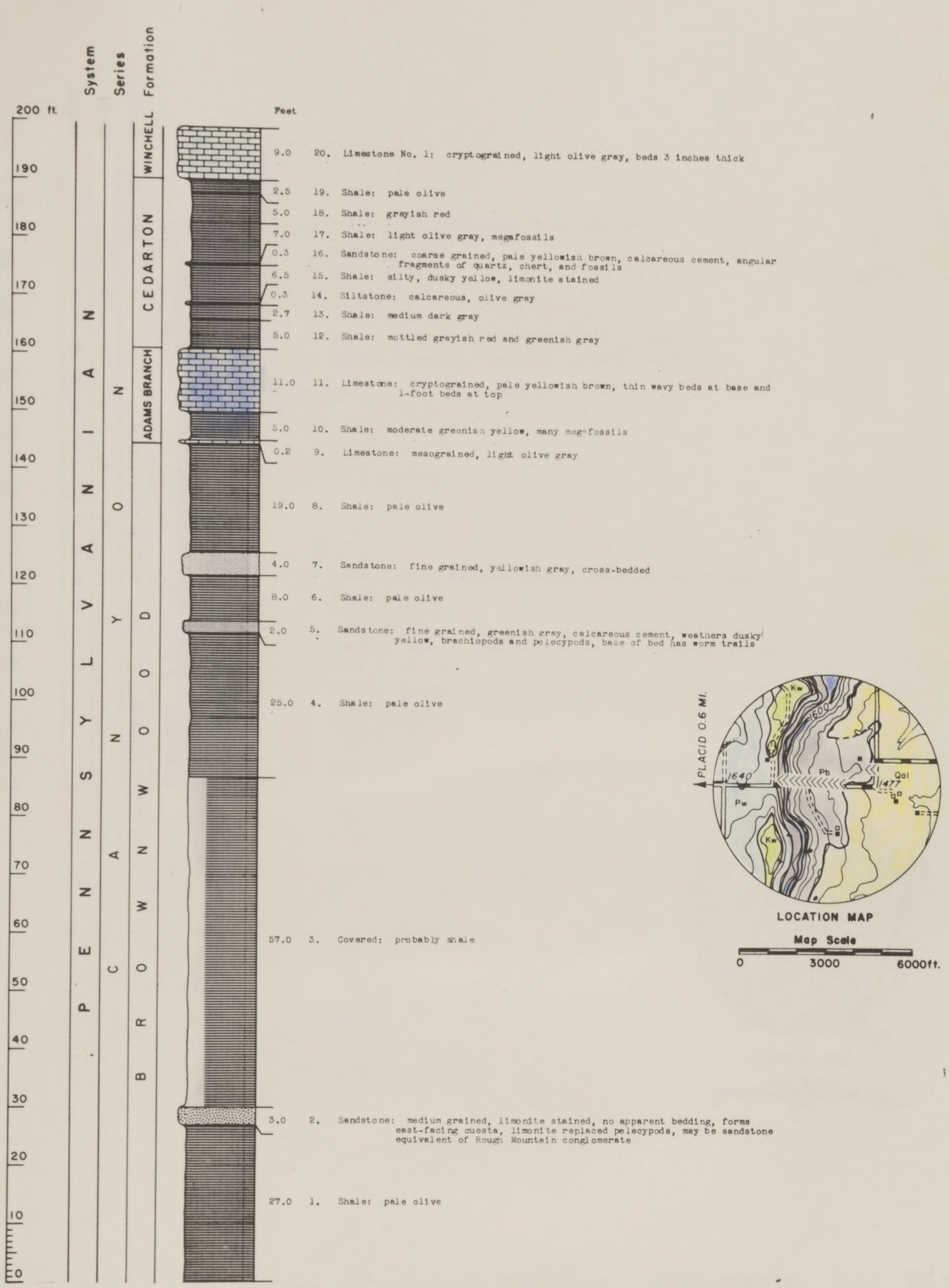


Figure 22. - Section of Brownwood, Adams Branch, Cedarton, and Winchell formations 1 mile east of Placid, McCulloch County, Texas.

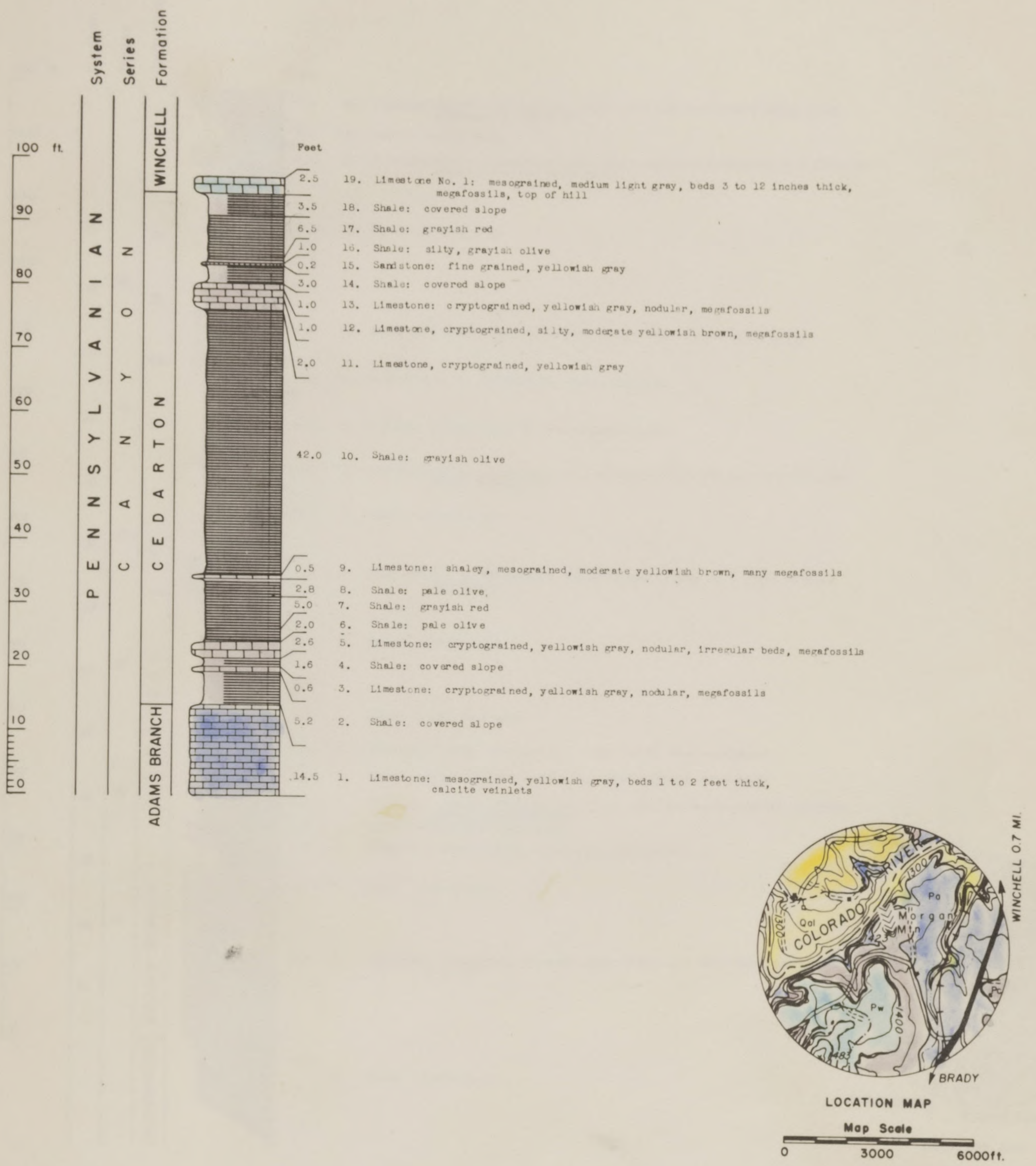


Figure 23. - Section of Adams Branch, Cedarton, and Winchell formations at Morgan Mountain, 1 mile southwest of Winchell, McCulloch County, Texas.

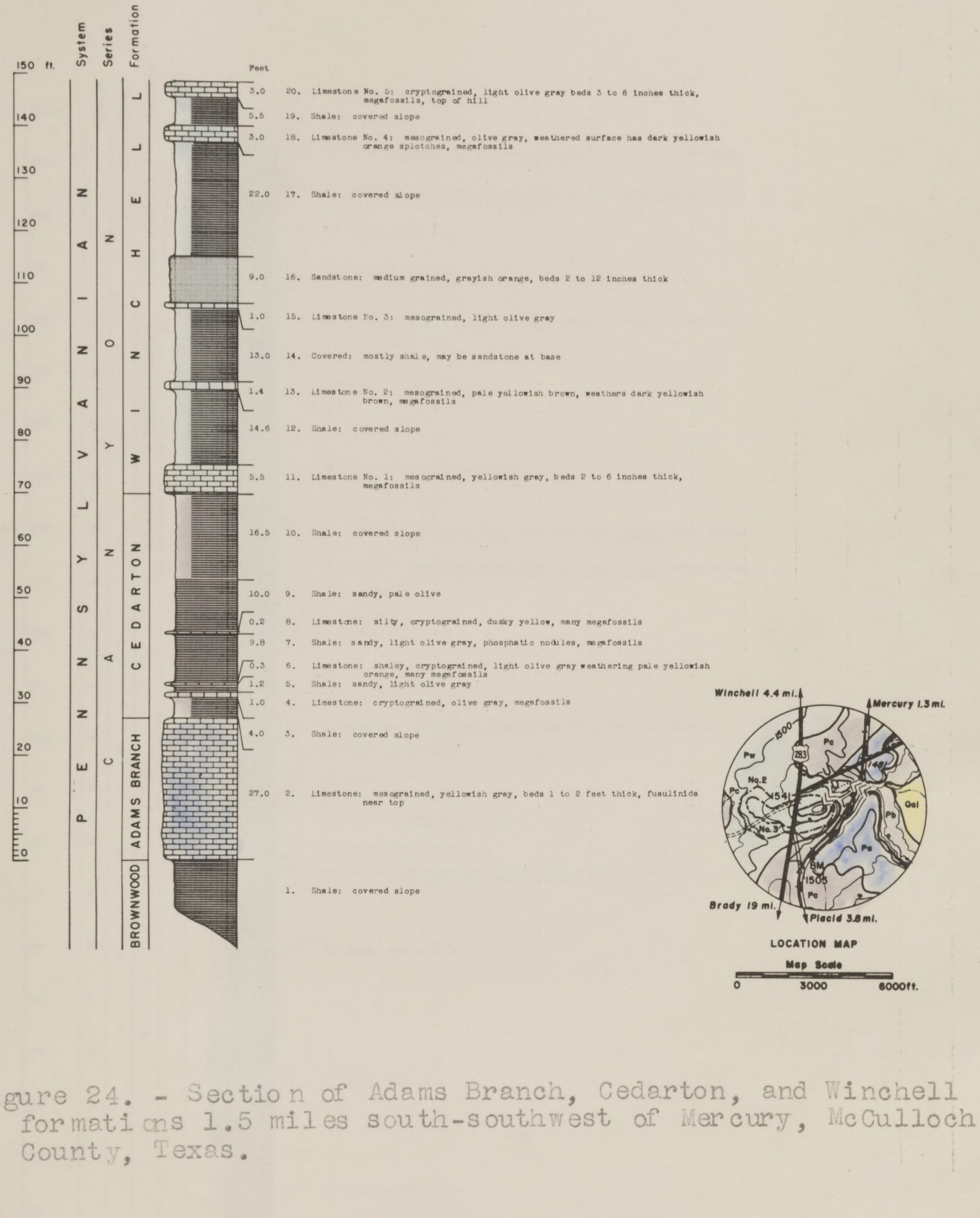


Figure 24. - Section of Adams Branch, Cedarton, and Winchell formations 1.5 miles south-southwest of Mercury, McCulloch County, Texas.

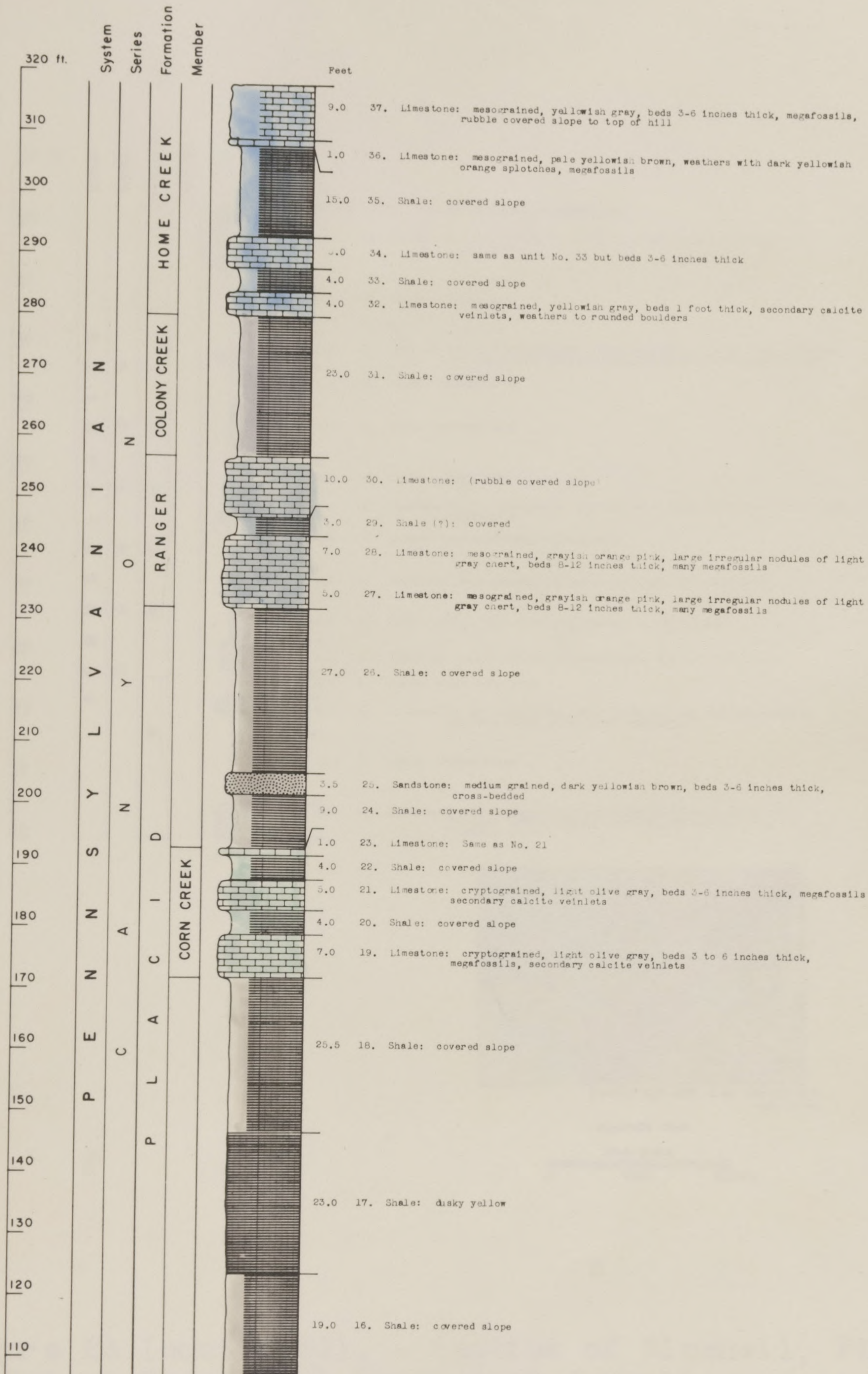


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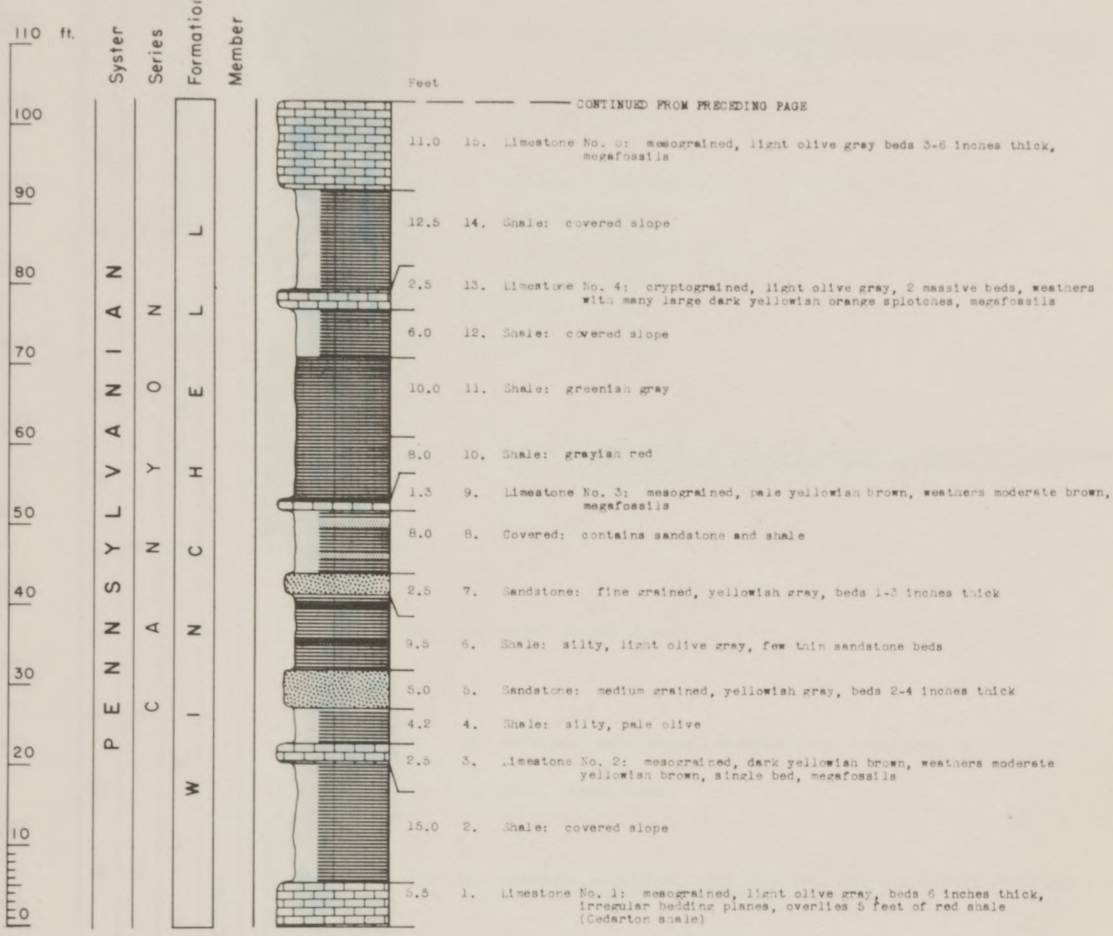
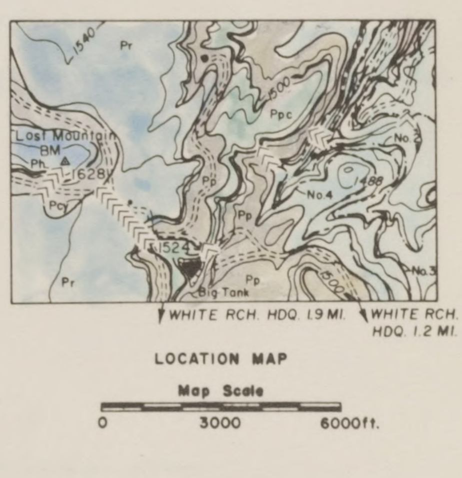
Figure 25. - Section of Winchell, Placid, Ranger, Colony Creek, and Home Creek formations west of Mercury on W. N. White and Company Ranch, McCulloch County, Texas.





LOCATION MAP

Figure 25 (continued). - Section of Winchell, Placid, Ranger, Colony Creek, and Home Creek formations west of Mercury on W. N. White and Company Ranch, McCulloch County, Texas.

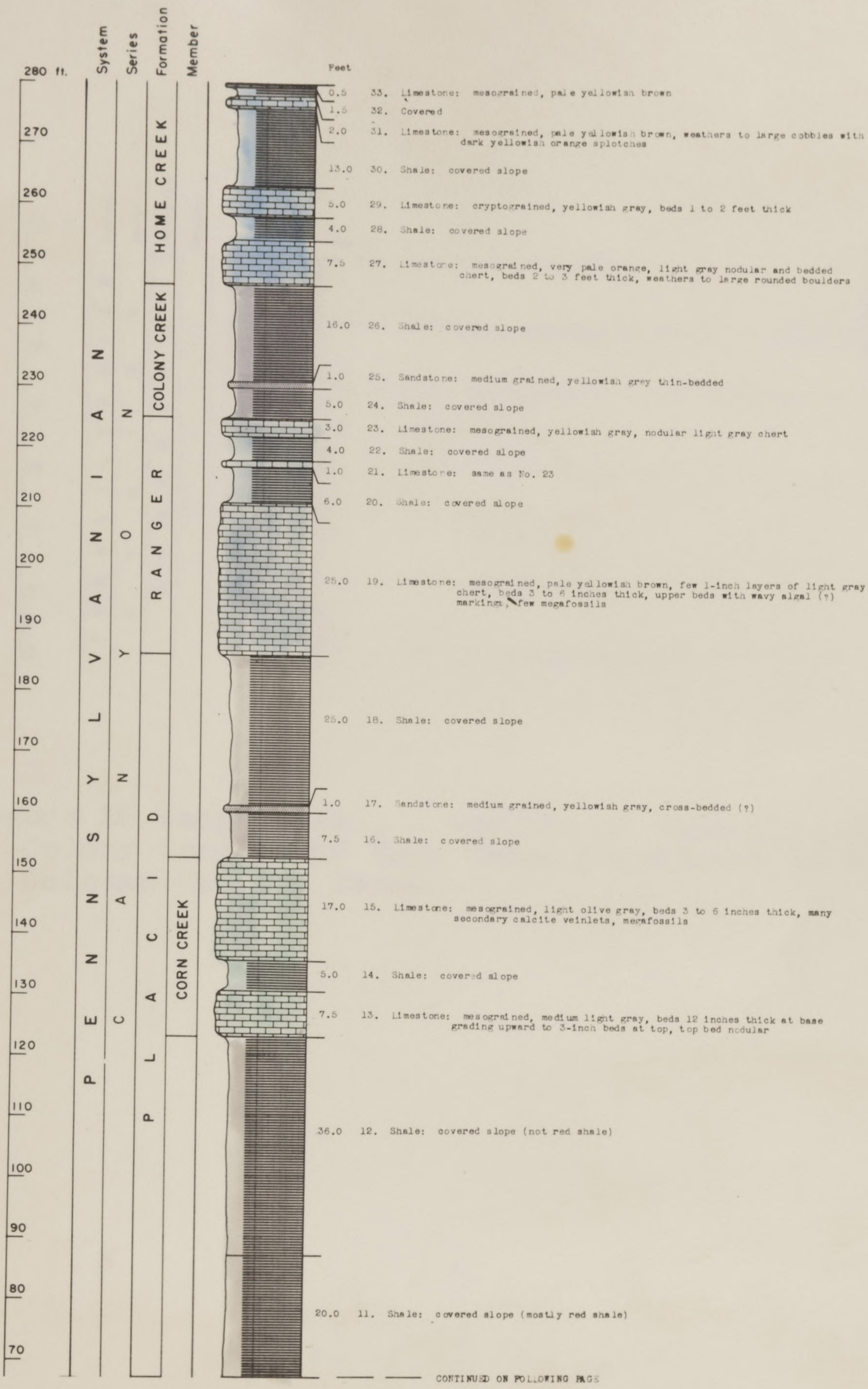


Figure 26. - Section of Winchell, Placid, Ranger, Colony Creek, and Home Creek formations in southeastern Coleman County, Texas.

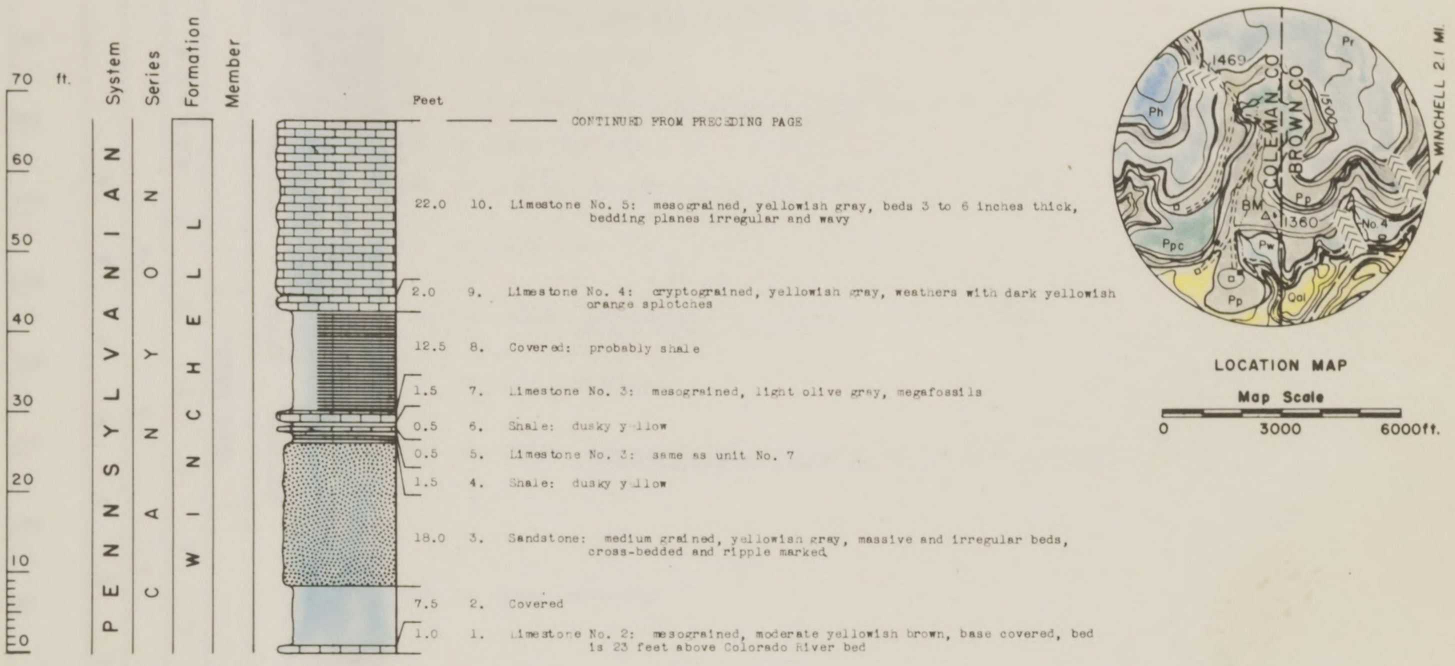


Figure 26 (continued). - Section of Winchell, Placid, Ranger, Colony Creek, and Home Creek formations in southeastern Coleman County, Texas.

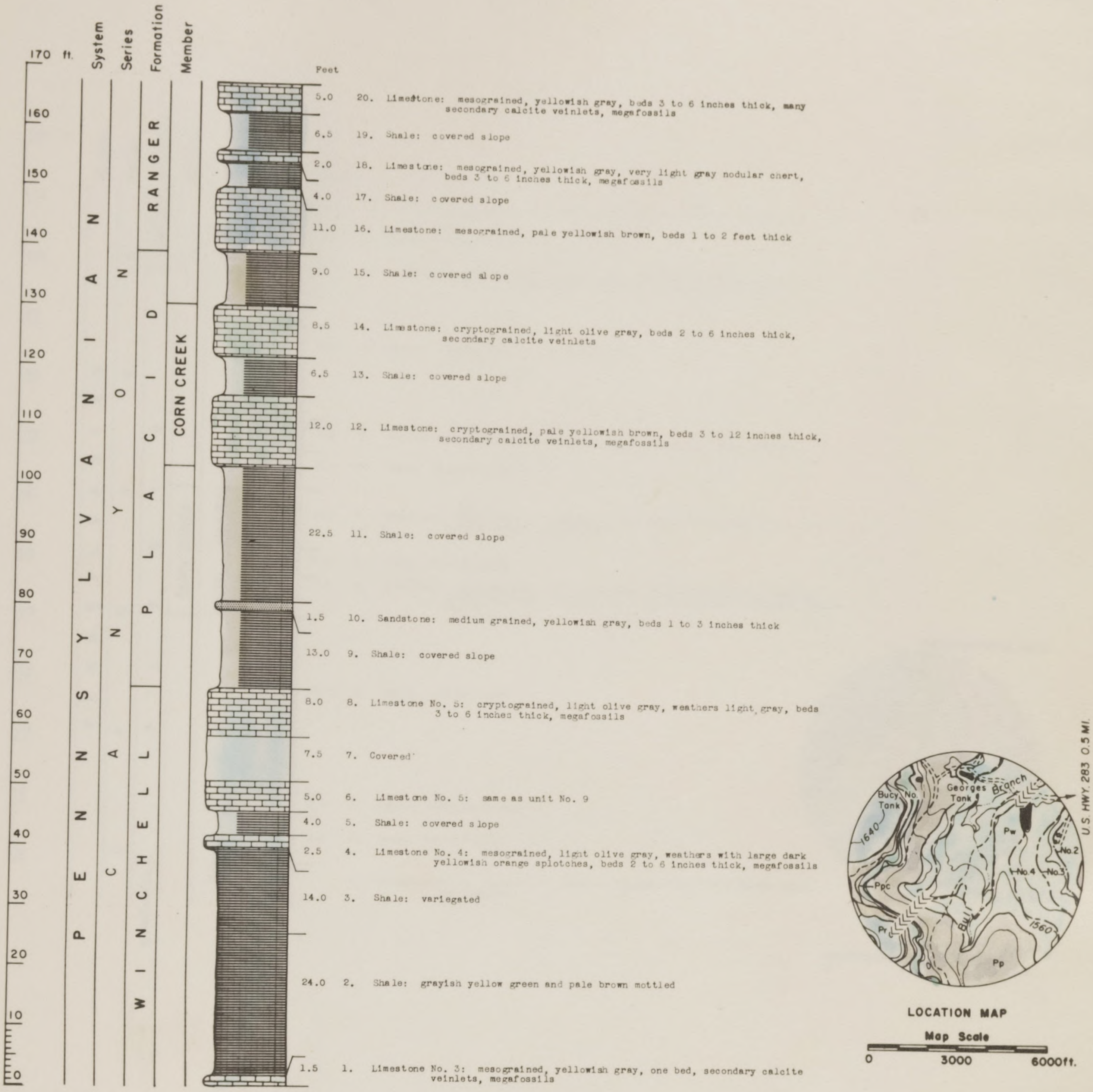


Figure 27. - Section of Winchell, Placid, and Ranger formations on D. S. Pumphrey Ranch, 3 miles north of Placid, McCulloch County, Texas.

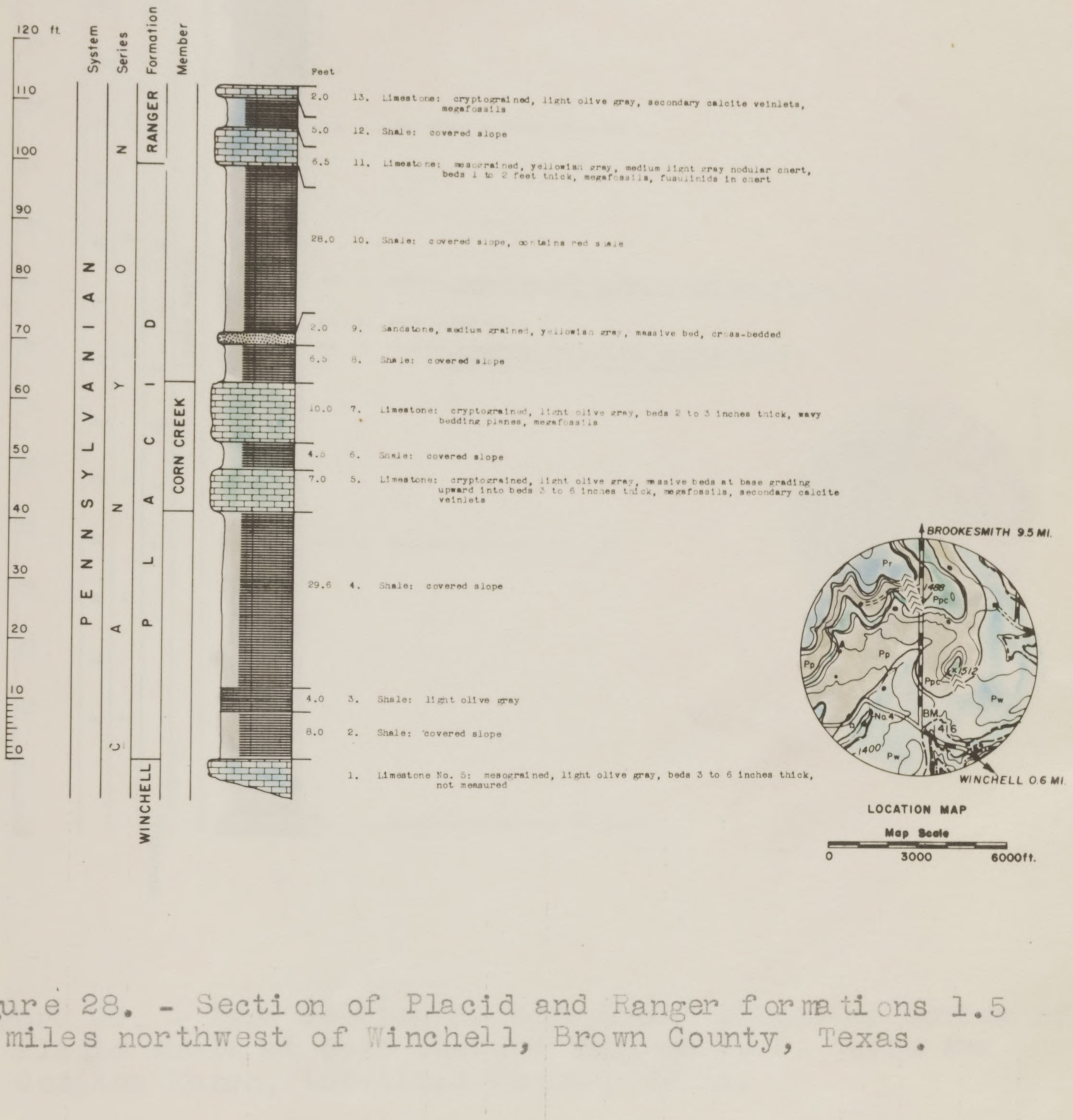


Figure 28. - Section of Placid and Ranger formations 1.5 miles northwest of Winchell, Brown County, Texas.

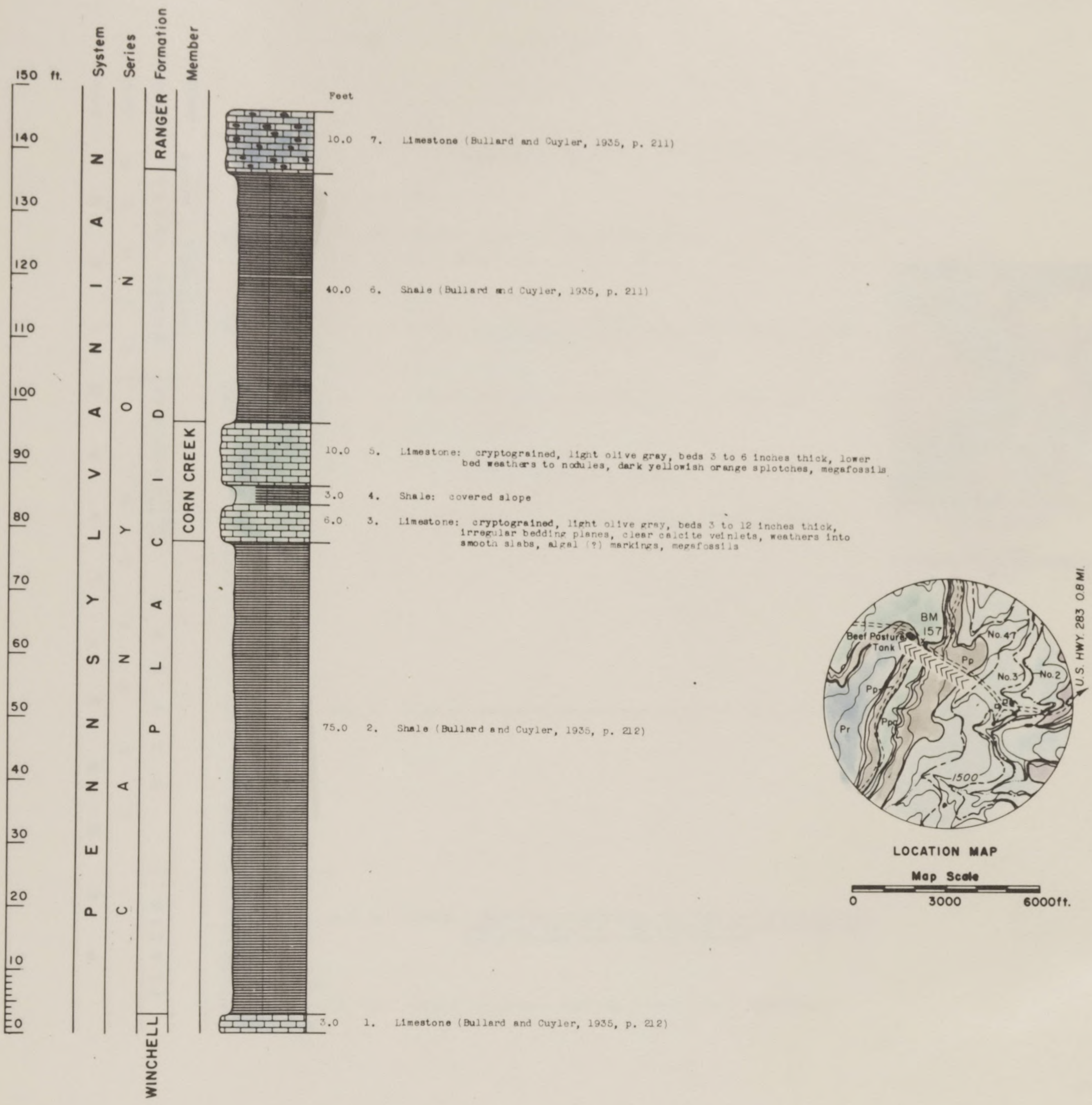


Figure 29. - Type section of Corn Creek limestone member of Placid shale at Beef Pasture Tank on W. N. White and Company Ranch, McCulloch County, Texas.

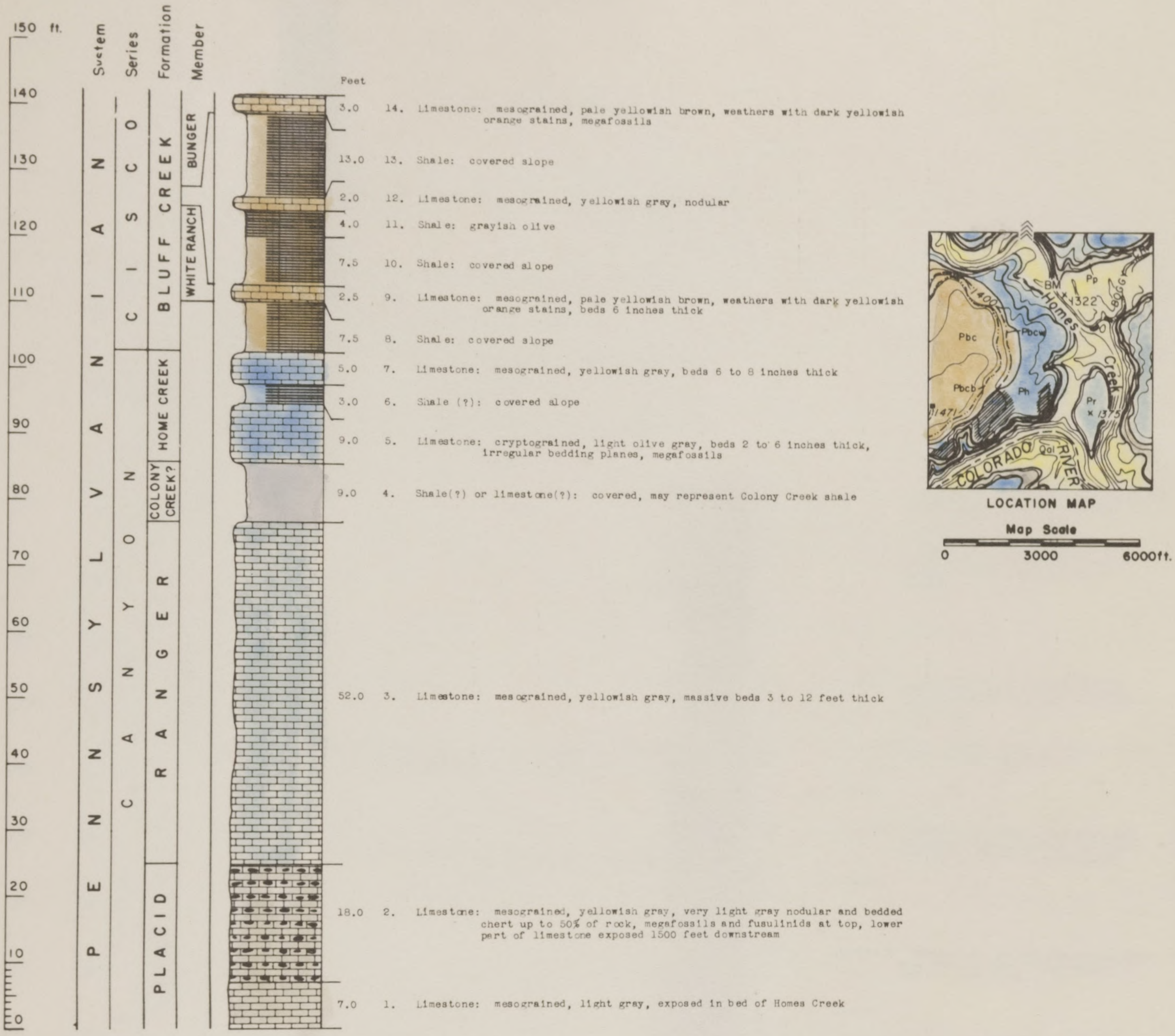


Figure 30. - Section of Placid (cherty limestone), Ranger, Colony Creek, Home Creek, and Bluff Creek formations on Homes Creek 2000 to 3000 feet northwest of mouth of Boggy Creek, Coleman County, Texas.

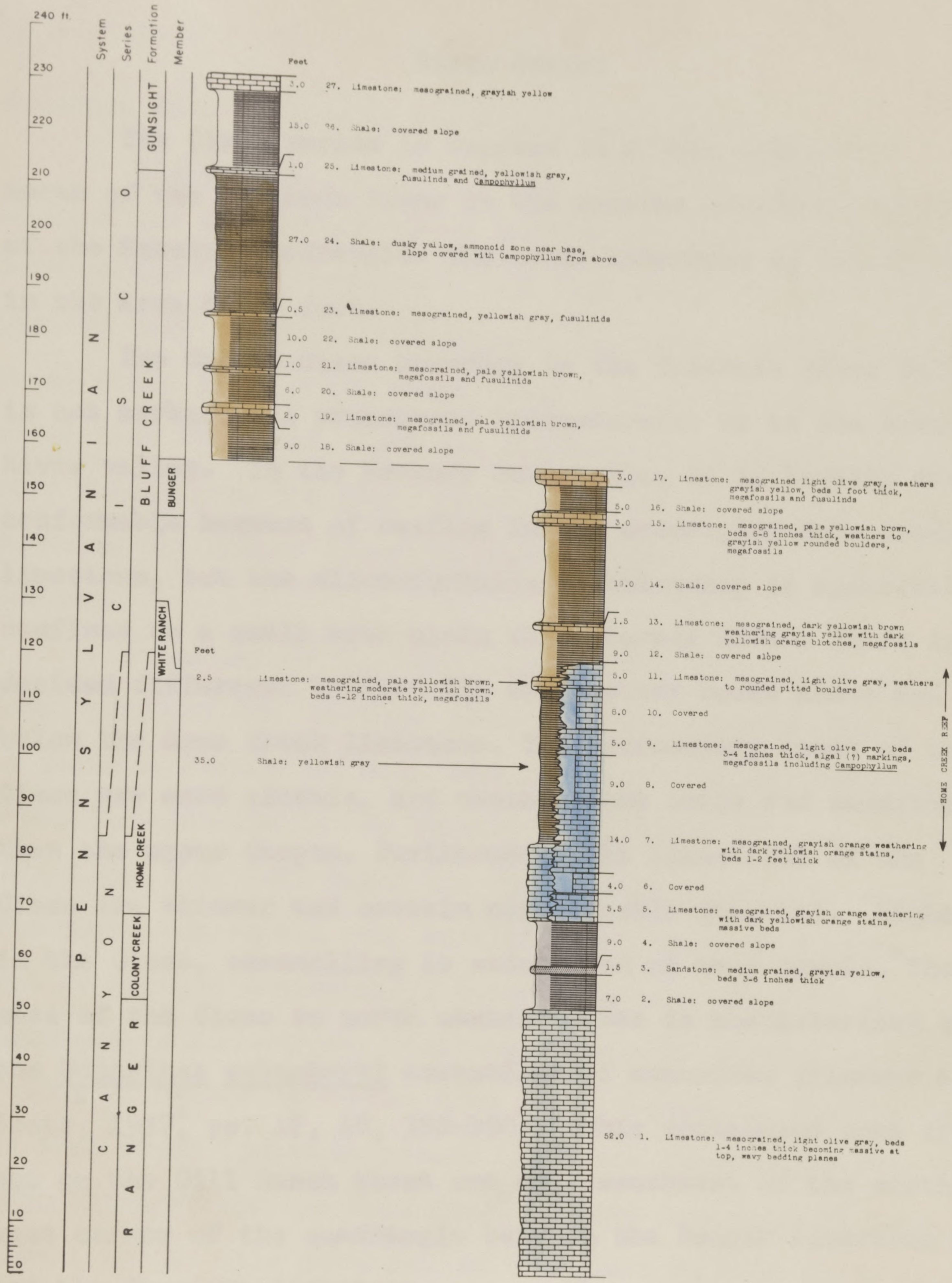


Figure 31. - Composite section of Ranger, Colony Creek, Home Creek, Bluff Creek, and Gunsight formations on Gill Ranch between ranch house and Homes Creek, Coleman County, Texas.

Cisco Series

The Cisco series is exposed in a very small area north of the Colorado River in the extreme northwest corner of the Mercury Quadrangle. The total thickness of the Cisco in the area is 77 feet.

The Canyon-Cisco boundary in the Colorado River valley is not marked by a pronounced disconformity as in the Brazos River valley. In the Mercury Quadrangle, it is locally disconformable because of reefing in the underlying Home Creek limestone, but the disconformable relationship is apparently confined to a small area along the Colorado River. There is a decided difference between the sedimentary rocks above and below the Home Creek limestone. The sedimentary rocks of the Cisco are more clastic, and contain more shale and sandstone than the upper Canyon. Furthermore, the limestones of the Cisco are thinner and contain more clastic material. Higher in the Cisco, channelling is widespread at many levels. The base of the Cisco in north central Texas is characterized by the Uddenites schucherti assemblage of ammonites (Plummer and Scott, 1937, pp. 17, 18, 388-390). This cephalopod zone crops out on the Gill Ranch about one mile southwest of the northwest corner of the quadrangle between the Bunger limestone member and the Gunsight limestone.

Cisco nomenclature used in this report as well as interpretations of the stratigraphy by previous workers in the

Colorado River valley is shown in Figure 10.

<u>Bluff Creek shale</u>. - Drake (1893, pp. 387, 400) applied the name "Bluff Creek bed" to the shale and sandstone between the "Home Creek bed" (not type area) and the "Campophyllum bed" (Gunsight limestone). The type area for the Bluff Creek shale is on Bluff Creek about 6 miles upstream (southwest) from the place where the Colorado River enters the Mercury Quadrangle. The Bluff Creek shale of the present report contains the Bunger limestone and the White Ranch limestone members.

A section of the Bluff Creek shale exposed on the Gill Ranch north of the Colorado River and west of Homes Creek is shown in Figure 31. Only beds up to the top of the Bunger member are present in the Mercury Quadrangle. Bullard and Cuyler (1935, pp. 221, 222) named the White Ranch limestone member from exposures on the west bank of Cedar Creek (1.5 miles west of Mercury Quadrangle). Outcrops of the White Ranch limestone in the Mercury Quadrangle occur at various stratigraphic intervals above the Home Creek limestone. Reefing in the Home Creek limestone causes the shale interval between the White Ranch member and Home Creek to vary from 0 to 35 feet. At a locality one mile northwest of the mouth of Home Creek the reef builds up to a level above the White Ranch member. The interval between the White Ranch limestone member and Bunger limestone member is 30 feet in the Mercury Quadrangle. The Bunger limestone member of this report is at about the same stratigraphic position as the Bunger limestone at its type locality (Young County, Texas), but exact correlation of the Bunger of the Colorado River with the Bunger at the type area has not yet been established. Previous common application of the name in McCulloch, Coleman, and Brown counties justifies its continued use rather than the introduction of a new name.

COMANCHE SERIES

Lower Cretaceous rocks dipping southeastward less than 10 feet per mile unconformably overlie Pennsylvanian strata in the Mercury Quadrangle. Nomenclature of the Comanche series used in this report is as follows:

- Comanche series
  - Fredericksburg group
    - Edwards limestone
    - Comanche Peak limestone
    - Walnut clay
  - Trinity group
    - Paluxy sand (northeastern Llano uplift only)
    - Glen Rose limestone
    - Travis Peak formation
      - Hensell sand
      - Cow Creek limestone
      - Sycamore sand

Barnes (1948, pp. 5-8) revised the nomenclature of the Trinity group as follows:

Trinity group
    Shingle Hills formation (new)
        Glen Rose limestone member
        Hensell sand member
    Travis Peak formation (restricted)
        Cow Creek limestone member
        Sycamore sand member

Well data and surface measurements show that the total thickness of Comanche strata in the quadrangle is about 240 feet. In the southeast, the Walnut, Comanche Peak, and Edwards formations are exposed at the eastern end of the Brady Mountains. In the south-central part of the quadrangle, a large outlier of conglomerate and sandstone is exposed as an elongate dissected mesa. The conglomerate and sandstone are tentatively correlated with the Hensell sand member of the Travis Peak formation (Shingle Hills formation of Barnes) for reasons stated below.

Travis Peak formation. - The Travis Peak formation consists of 20 to 40 feet of sandstone and conglomerate overlying Strawn shale and sandstone. A part of the Travis Peak formation is described in Figure 9. As pointed out by Drake (1893, p. 361), the conglomerate deposits of the Lower Cretaceous are found west of the cuesta-forming limestones of the Canyon series and at a lower elevation than Cretaceous beds to the west. The elevation of the Cretaceous-Pennsylvanian contact east of Deep Creek where the Travis Peak formation is present varies from 1550 to 1610 feet, the lowest elevations occurring at the north end of the large outlier. Elevations of the Cretaceous-Pennsylvanian contact west of Deep Creek average about 1700 feet, the Walnut formation resting directly on the Pennsylvanian. This difference in elevation of the Pennsylvanian-Cretaceous contact is interpreted to be the result of variations in topography on the pre-Cretaceous erosional surface. Where the underlying Pennsylvanian contains beds of resistant limestone, the Pennsylvanian-Cretaceous contact is higher than where the underlying beds are composed of less resistant sandstone and shale. The Travis Peak sandstone and conglomerate may represent the Hensell sand member below the Glen Rose limestone. Barnes (1948, p. 8) has shown that a part of the Hensell sand is a shoreward facies of the Glen Rose limestone. Because of the unevenness of the pre-Comanche erosional surface, the Glen Rose limestone is absent in the Mercury Quadrangle, making the relationship of the conglomerate to overlying beds obscure. This relationship is further complicated by the progressive overlap of younger Comanche formations southeastward on the Llano uplift.

Damon (<u>in</u> Plummer 1950, pp. 103, 104) has made a detailed study of the Travis Peak conglomerate at two localities in the Mercury Quadrangle (one locality is 2.4 miles north and 0.5 mile west of Hall; another is 2.4 miles north and 2.0 miles west of Hall). Lithologic analyses of the pebbles and cobbles in the conglomerate indicate a dominance of rock types characteristic of the Ellenburger and Marble Falls. The nearest source for these rock types is the Llano uplift to the south.

Directly overlying the Travis Peak conglomerate in some areas is a deeply weathered zone of limestone rubble which may represent the overlying Glen Rose. All observed outcrops contain thick caliche deposits, obscuring the stratigraphic relationship to the underlying conglomerate. These weathered limestone deposits were mapped as a part of the Travis Peak formation. Stratigraphic work to the south and west of the quadrangle should solve some of the problems related to the interval between the Travis Peak conglomerate and the Walnut formation.

Walnut formation. - The Walnut outcrop is west of Deep Creek, overlying the alternating limestones and shales of the Canyon series. The soft clay of the Walnut is extensively cultivated and forms wide, flat areas with very few outcrops. Consequently, only the top portion of the Walnut is included in the measured section of the Cretaceous (Figure 32). A water well drilled in the Corn Creek Hills on the Parker

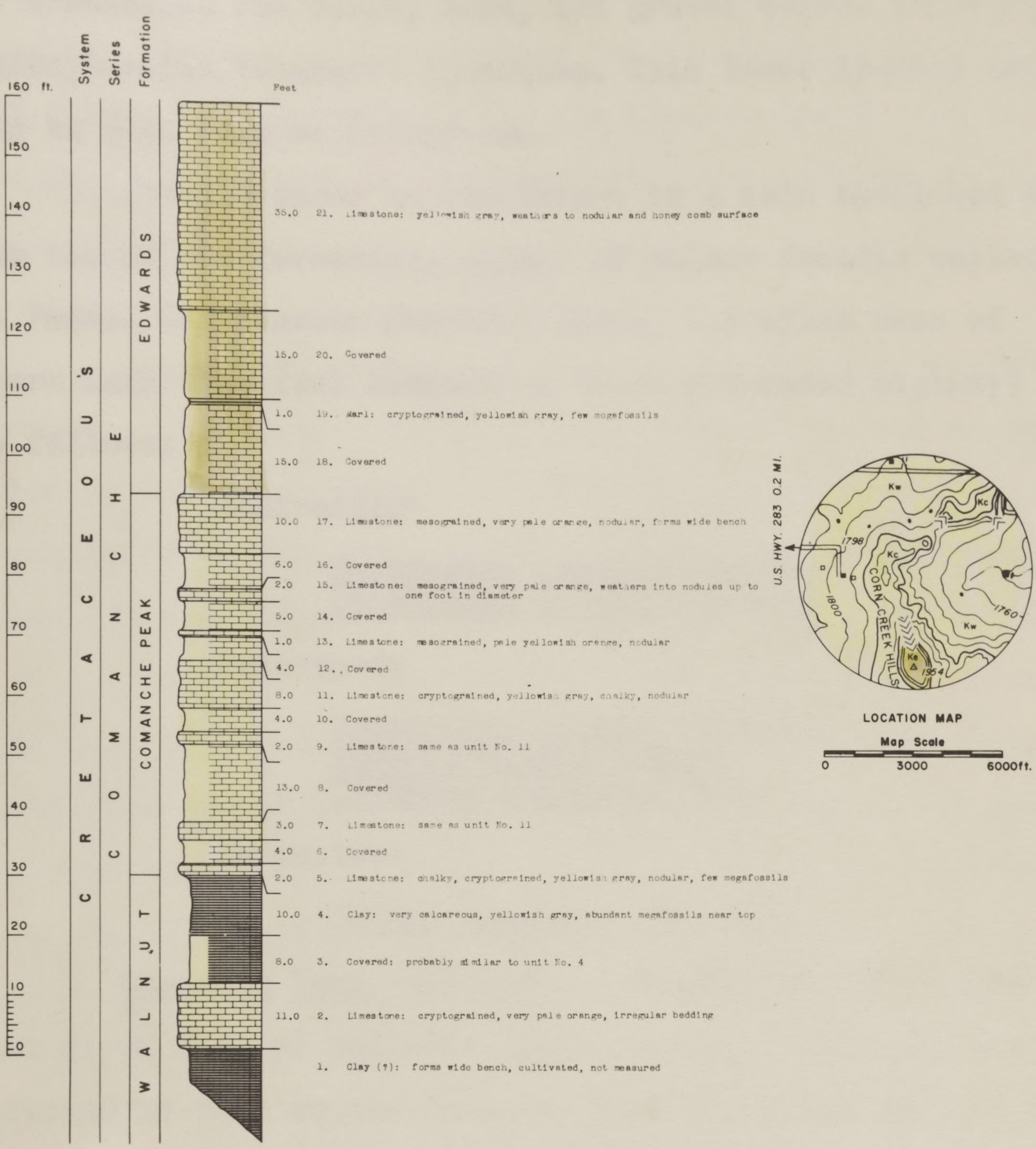


Figure 32. - Section of Walnut, Comanche Peak, and Edwards formations on Parker Pumphrey Ranch, Corn Creek Hills, McCulloch County, Texas.

Pumphrey Ranch penetrated 82 feet of Walnut clay and 19 feet of Cretaceous red shale, sand, and gravel before entering Pennsylvanian (Ranger?) limestone. This lower 19-foot section may be Glen Rose or Paluxy age.

Fossils occur in the Walnut in a thin shell bed at the top of the formation. A list of Walnut fossils collected at Fossil Gap (Parker Pumphrey Ranch, 1.3 miles east of bench mark 1740 feet located on Brady-Brownwood highway) is as follows:

Echinoidea

Heteraster texanus (Roemer)
Holectypus planatus Roemer

Pelecypoda

Cyprimeria texana (Roemer)
Exogyra texana Roemer
Gryphaea mucronata Gabb

Ammonoidea

Metengonoceras hilli Böhm

Comanche Peak Limestone. - Immediately above the Walnut clay is 60 feet of yellowish gray, nodular limestone which is referred to here as the Comanche Peak limestone (Figure 32). This formation makes a wide bench below the steep-sided outliers of Edwards limestone. Lithologically the Comanche Peak limestone is distinct from the underlying Walnut or overlying Edwards limestone.

Edwards limestone. - The Edwards limestone forms three flat-topped mesas in the Mercury Quadrangle. The thickness of the Edwards in the Corn Creek Hills is 66 feet (Figure

32). The Edwards of this area is characteristically harder than the Comanche Peak limestone and weathers to large cavernous and honeycombed blocks. Unlike the Edwards farther west in the Brady Mountains, no rudistids or chert nodules are present.

QUATERNARY SYSTEM

Quaternary deposits mapped in the Mercury Quadrangle consist of two units: older terrace gravel adjacent to the Colorado River (probably Pleistocene), and younger flood plain deposits of the Colorado River and its major tributaries (Pleistocene (?) and Recent). These deposits were mapped only in part.

The older terrace gravel is interpreted as a deposit laid down by the Colorado River probably during the Pleistocene epoch. The gravel is composed mainly of rounded chert pebbles and cobbles. Its base occurs 80 to 120 feet above the normal river level, sloping downstream at about the same rate as the present gradient of the Colorado River. The gravel ranges in thickness from 0 to 30 feet, being at places extensive enough to be used as a source of road metal.

Gravel, sand, and silt, mapped as Quaternary alluvium are present along the Colorado River and its major tributaries. At the mouth of Deep Creek the alluvium consists of 5 to 6 feet of basal sand and gravel overlain by 50 feet of silt. The silt occurs up to 60 feet above the present river level. Where the Colorado River traverses the wide outcrop of the Brownwood shale, the silt extends north and south of the river, merging into similar deposits laid down by Conner Branch and Deep Creek. At higher elevations on Deep Creek, the alluvium grades into slope wash from the valley walls. The thick silt and gravel deposits along the Colorado River are interpreted as mostly Recent age but may be in part Pleistocene.

STRUCTURAL FEATURES

The structural features can be divided into three divisions, each of which is related in time and type of deformation:

1. folded pre-Strawn strata of the Llano uplift;
2. northwest-dipping Strawn, Canyon, and Cisco strata; and
3. southeast-dipping Lower Cretaceous strata.

Pre-Strawn beds in the southeast dip 3° to 4° north and northwest away from the center of the Llano uplift. These rocks are on the west flank of the Richland Springs axis - a broad arch that trends northeastward across the Llano uplift, and can be traced in the subsurface to the north where it has been called the Bend arch or Bend flexure.

A smaller structural feature on the west flank of the

Richland Springs axis has been named the Hall uplift. The north end of this plunging anticline is in the Mercury Quadrangle. The axial trace of the anticline trends N 15° E. Dips on the east and west flanks of the Hall uplift average 8° to 10°, at places reaching a maximum of 15°. South of the quadrangle, the east flank of the anticline is cut by a normal fault whose surface trace trends northeastward.

Strawn, Canyon, and Cisco strata dip N 70° W at an average rate of 50 to 75 feet per mile. The structural feature formed by these beds is a homocline modified locally by faulting or gentle folding. Plate 2 shows the regional dip with minor nosing in the western half of the quadrangle.

Two faults have been observed in the Mercury Quadrangle involving Canyon beds, one south of Mercury, the other along the Colorado River near the northwest corner of the quadrangle. Both faults are oblique, high-angle, normal faults. The fault south of Mercury is downthrown to the southeast and has a maximum observed throw of 32 feet on the old Placid-Mercury road. The throw diminishes to the southwest. Northeast of the old Placid-Mercury road, the fault can not be traced a great distance because of the homogeneity of the Brownwood shale and Quaternary alluvium cover. The fault on the Colorado River is mapped as an inferred fault on the Mercury Quadrangle. This fault has been clearly defined to the southwest on the adjacent Waldrip Quadrangle. The downthrown side of the fault is to the northwest and the maximum calculated throw is about 70 feet.

Other dips anomalous to the regional dip are present in the form of structural noses and terraces. A comparison of the structure-contour map (Plate 2) with the areal geology map (Plate 1) shows that most of the structural noses are reflected in the outcrop pattern. For example, inliers coincide with the minor folds 2 miles northwest of Placid, 2.8 miles southwest of Mercury, and 2.5 miles north of Mercury.

The attitude of Cretaceous strata in the southwest is homoclinal; they dip southeast less than 10 feet per mile. These figures are based on the changes in elevation of the fossil bed at the top of the Walnut formation.

GEOLOGIC HISTORY

INTRODUCTION

Strawn, Canyon, and Cisco strata in the Mercury Quadrangle exhibit many stratigraphic features which are similar to those formed by cyclic sedimentation, but the cyclic repetition of the beds is thought to be interrupted at so many levels that complete cycles are probably absent. The probable reason for the apparent random periods of interruption in the cyclothems is sporadic uplift of the borderland. More surface and subsurface data are needed before these interrupted cycles can be fully understood.

In the following discussion of the geologic history of the Strawn, Canyon, and Cisco series of the Mercury Quadrangle, certain conclusions have been reached which apply to the depth of water in which various types of rocks and associated fossils have been deposited. Most of these conclusions are based on previous work of different geologists in other Pennsylvanian and Permian strata that show cyclic sedimentation.

As the upper Pennsylvanian formations in the Mercury Quadrangle closely resemble in lithology and type of fossils the Big Blue series in Kansas (Elias, 1937, pp. 403-432), it is believed that the environments of the Upper Pennsylvanian sea in the Colorado River valley correspond closely to the Big Blue environments. Elias (1937, pp. 423, 425) concluded that the maximum depth of the late Paleozoic sea in Kansas was less than 200 feet. This maximum depth might well apply to upper Pennsylvanian sediments in the Mercury Quadrangle.

The following list shows an interpretation of the relative depths (from shallow to deep) at which different types of Pennsylvanian sediments in the Mercury Quadrangle were deposited. These depths are inferred in part from stratigraphic relationships involving position in a cyclothem, and in part on the conclusions reached by Elias. His numerical depths of similar rock types in Kansas are given for comparison.

1. Sandstone and chert conglomerate: the cross-bedded, channel-like types were deposited above sea-level; Elias placed Big Blue sandstones above sea level.
2. Red shale: red shale may be deposited above sea level or very near shore under oxidizing conditions; plant fossils are present at some places; at many places (surface and subsurface) red shale overlies sandstone suggesting a close relationship to subaerial deposits; Elias places red shale above sea level.
3. Green shale: green shale rarely contains fossils; deposited under reducing conditions; found mixed with red shale, therefore closely related; Elias places green shale from sea level to 30 feet below sea level.
4. Gray shale: may contain crinoids, bryozoans, brachiopods, pelecypods, gastropods, trilobites, conodonts, ostracodes, and foraminifers, but no fusulinids; may be shallow to deep water; Elias

places gray shale from 60 to 160 feet below sea level.

5. Limestone without fusulinids: contains brachiopod fauna; Elias places this type 110 to 160 feet below sea level.

6. Limestone containing chert and limestone containing fusulinids: Elias places these types 160 to 180 feet below sea level or maximum depth of the sea.

PRE-STRAWN TIME

The calcitic limestone in the Ellenburger has been likened in origin to the chemical precipitation of aragonite mud on the Bahama Banks at present (Cloud and Barnes, 1948, pp. 89-109). The fine texture and small amount of terrigenous material found in the calcitic limestone (e. g. Gorman formation) point toward a neritic environment, probably offshore from a landmass of low relief (Cloud and Barnes, 1948, pp. 89-109).

Post-Ellenburger truncation, increasing from east to west is demonstrated by the absence of the Honeycut formation (upper Ellenburger) on the west side of the Llano uplift. In the Mercury Quadrangle the Honeycut formation is absent, Mississippian strata overlying the Gorman formation. Cloud and Barnes (1946, p. 109) have dated this truncation as pre-Devonian because widespread but isolated Devonian beds overlie progressively older Ellenburger strata from east to west.

The fact that Devonian beds have been almost entirely removed from the Llano uplift is indicative of post-Devonian uplift and erosion.

The Ives breccia is thought to represent the initial marine invasion of Mississippian seas in the Llano region (Cloud and Barnes, 1946, p. 317). In the Mercury Quadrangle the Ives breccia rests unconformably on an old erosional surface of the Gorman formation. The presence of conodonts in the sand matrix, the nearby source (Ellenburger chert), and angularity of the chert phenoclasts, and the uniform thickness of the breccia point to a rapid marine invasion over a land of low relief which had been exposed to weathering for a long period of time. Absence of the Chappel limestone above the Ives breccia in the Mercury Quadrangle indicates a post-Chappel, pre-Barnett period of uplift and erosion.

The next marine invasion is represented by deposits of silt, limestone, and shale of the Barnett formation. Even though outcrop sections of the Barnett are thin, the Barnett sea was extensive, covering a large area in Central Texas. Subsurface data show that the Barnett is absent over areas of greatest uplift (Cheney, 1940, p. 71) probably due to pre-Pennsylvanian erosion.

Pennsylvanian sedimentation in the Mercury Quadrangle was initiated by the deposition of the Lemons Bluff member of the Big Saline formation, which unconformably overlies the Barnett shale, intervening Big Saline deposits being absent. According to Plummer (1950, p. 64, 65) the older Big Saline beds (Aylor and Brook members) pinch out on the flanks of the uplifts and are overlapped by the Lemons Bluff member. If this is true, the Hall uplift was structurally positive before Big Saline time. Before or during Smithwick time renewed uplift in positive areas similar to the Hall uplift is inferred from the thick deposits of Smithwick shale in synclinal areas adjacent to the positive areas. The Smithwick may be thicker west of the Hall uplift for this reason but subsurface data at present are insufficient to support this postulation.

STRAWN EPOCH

The geologic history of the Strawn epoch in the Colorado River valley is essentially a reflection of orogenic movements of the inferred Ouachita Mountains. The foreland sandstone-shale sequence mapped and described by Drake along the Colorado River from Nix, Lampasas County, to Milburn, McCulloch County, indicates a rhythmical change from littoral and fluvial sand to near-shore marine, perhaps in part lagoonal, silt and clay. At the outcrop, the thickness of the Strawn is more than 3800 feet (Plummer and Moore, 1922, p. 63). Drilled thicknesses of the Strawn in the Colorado River valley are considerably less than might be expected. For example, in northeast McCulloch and northwest San Saba Counties where the top of the Strawn is near the surface, wells penetrated about 600 feet of Strawn. These thin, subsurface Strawn deposits may represent the offshore facies of the thicker, clastic deposits which are exposed at the surface.

The alternating sandstones and shales suggest an oscillating strand line during Strawn time. Periodic uplifts of the Ouachita Mountain belt to the east accompanied by slight foreland subsidence would have moved the strand line westward allowing sand to accumulate. Fluvial deposits (conglomerate and sandstone) filled channels cut by major streams, originating in the highlands. As the relief of the mountains decreased, the coarser clastic material gave way to near-shore shale and silt, the strand line moving eastward. Renewed uplift of the mountains would begin a new cycle.

The upper part of the Strawn in the Mercury Quadrangle has more marine elements than do the older beds. Near the top of the "Indian Creek bed," a thin limestone contains marine fossils (Figure 7, Unit No. 3). This occurrence of limestone suggests a shallow, offshore, clear-water, marine environments as compared to the turbid waters which are interpreted for the underlying unfossiliferous shales. The Capps limestone, which contains fusulinids and corals, also indicates deposition in marine water. The limestone in the "Indian Creek bed" lies a few feet below chert conglomerate, and the Capps limestone is locally replaced by Chert conglomerate. This conglomerate and associated sandstone are interpreted as the beginning or nonmarine phase of a new sedimentary cycle.

During the time in which the Strawn was being deposited in the Colorado River valley, a period of major faulting occurred along a northeast trend, affecting Strawn and older rocks across the Llano uplift. The faults are normal, high angle, gravity faults. According to Cheney (1940, p. 105) the faulting was caused by tension in an area which was marginal to a stable or rising foreland and which was flanked by a deeply subsiding geosyncline. Most of these faults lie east and southeast of the Bend Arch or Richland Springs axis (east of Mercury Quadrangle). Where this zone of faulting is exposed in the Llano uplift, it consists of narrow, parallel grabens, trending northeast. Cheney (1950, p. 17) states that Drake's "Big Valley beds" and older were affected more by the major faulting than younger Strawn beds. Thus Cheney would place the age of greatest crustal movement along the faults between "Big Valley" and "Brown Creek" times at the close of his Lampasas (Figure 5).

That the Llano uplift was a positive area from late Strawn time to the present is demonstrated by the overlap of Strawn, Canyon, and Cretaceous strata around the margin of the uplift.

CANYON EPOCH

Canyon formations represent a change from the near-shore, strand line deposits of the Strawn to a marine, clear-water environment. Canyon seas in the Mercury Quadrangle were shallow but the strand line is thought to have been farther east as compared to Strawn time. Uplift of the borderland to the east probably gave rise periodically to increased supplies of clastic material to be deposited between the marine limestones in the foreland seas.

Initial Canyon deposition in the Mercury Quadrangle is represented by the relatively thick Brownwood shale. The essential difference between the Brownwood shale and underlying Strawn deposits is the presence of more marine beds in the Brownwood. Locally the base of the Brownwood is marked by chert conglomerate, which is interpreted as a channel deposit. The source of the varicolored chert pebbles in the Canyon conglomerates (as well as Strawn and Cisco conglomerates) is thought to be the folded and uplifted earlier Paleozoic strata of the Ouachita-Marathon geosyncline to the east.

After the Brownwood shale was deposited, the Canyon sea became pogressively clearer, for limestone~~s~~ beds became more numerous and thicker. Periods of channelling occurred throughout the Canyon epoch at different times. Probably the most widespread channelling occurred just after the deposition of limestone No. 2 of the Winchell formation.

From upper Placid time (post-Corn Creek member) to the top of the Canyon, reefs were formed locally in a northeast trending belt along the northwest edge of the Mercury Quadrangle. Superposition of reefs along Homes Creek and the Colorado River is thought to be the result of reef growth on an old sea-floor shoal area that may have been a structural high.

CISCO EPOCH

No evidence of a major break in the sedimentary record between the Canyon and Cisco can be found in the Mercury Quadrangle. Locally the Home Creek-Bluff Creek contact is unconformable because of reef development in the Home Creek limestone, but this relationship exists at other horizons in the Canyon. When traced laterally away from the reefs, the unconformity ceases to be significant.

During lower Cisco time in the Colorado River valley, thin, fusulinid-bearing limestones and thick, intervening shales were deposited. Ripple-marked sandstone and channels filled with chert conglomerate which are widespread in the lower Cisco (Bluff Creek shale) at other places in the Colorado River valley, indicate periods of uplift and erosion. In general, it might be said that during lower Cisco time in the Colorado River valley, the sea changed rapidly from turbid to clear, fusulinids flourishing in the clearer water.

POST-CISCO TIME

After early Cisco and before early Cretaceous time, (probably during the Permian and Triassic periods), regional tilting of Cisco and older beds to the west and northwest took place in north-central Texas, affecting the Mercury Quadrangle. The Mercury Quadrangle along with most of north-central Texas was uplifted before Lower Cretaceous time and subjected to a long period of erosion. The absence of the Travis Peak formation west of Deep Creek suggests that much of the present topography may have been cut as early as pre-Cretaceous time.

The Comanche sea, advancing from southeast to northwest, invaded the Mercury Quadrangle, where the maximum relief was more than 100 feet. The oldest conglomerates were deposited on the topographically lower and less resistant Strawn sandstone and shale. Cuestas formed by Canyon limestones evidently remained above sea level until Walnut time.

The absence of the Glen Rose limestone in the Mercury Quadrangle indicates that this region was topographically high during Glen Rose time. This is true for the Llano uplift in general. During Walnut, Comanche Peak, and Edwards time, the Mercury Quadrangle was covered by the Cretaceous sea. The marl, clay, and limestone indicate a near-shore, clear-water, marine environment.

The post-Edwards history of the Mercury Quadrangle is mainly one of erosion. After Edwards time the Comanche sea covered most of north-central Texas, but Cretaceous rocks younger than the Edwards are absent in the Mercury Quadrangle. Terrace gravel of Pleistocene (?) age was deposited by the Colorado River at topographic levels above the present drainage system, and Recent and Pleistocene (?) silt and gravel are found adjacent to the river and its tributaries.

APPENDIX A

LIST OF FOSSIL LOCALITIES IN THE MERCURY QUADRANGLE

The following list of fossil localities in the Mercury Quadrangle includes the localities described by Bullard and Cuyler (1935), Williams (1938), and Plummer (1950), and Early (1951). Arbitrary numbers preceded by the initials of the author and the date have been assigned to each locality. These numbers correspond to those found on Table I which shows the distribution of the fossil species, and Plate 3 which shows the fossil localities.

Bullard and Cuyler (1935) list fossils in their measured sections. Their localities are as follows:

Locality Number	Remarks
BC-35-1	Brownwood shale, 20 feet below base of Adams Branch limestone, 0.5 mile east of Mercury (Bullard and Cuyler, 1935, p. 201).
BC-35-2	Cedarton shale, railroad cut 2.5 miles south of Mercury (Bullard and Cuyler, 1935, p. 203).
BC-35-3	Cedarton shale, sandstone bed 10.2 feet below top, Morgan Mountain (Bullard and Cuyler, 1935, p. 204).
BC-35-4	Cedarton shale, 10.7 to 15.8 feet below top, Morgan Mountain (Bullard and Cuyler, 1935, p. 204).
BC-35-5	Cedarton shale, 11.4 to 51.2 feet above base, Morgan Mountain (Bullard and Cuyler, 1935, pp. 204, 205).

BC-35-6	Limestone No. 2 of the Winchell formation, near White Ranch house (Bullard and Cuyler, 1935, p. 207).
BC-35-7	Limestone No. 1 of the Winchell formation, near White Ranch house (Bullard and Cuyler, 1935, p. 207).
BC-35-8	Corn Creek limestone member of the Placid formation, Beef Pasture Tank on the White Ranch (Bullard and Cuyler, 1935, p. 211).
BC-35-9	Limestone No. 5 of the Winchell formation, west of White Ranch house (Bullard and Cuyler, 1935, p. 212).
BC-35-10	Limestone No. 2 of the Winchell formation, 2 miles southwest of Mercury (Bullard and Cuyler, 1935, p. 212).
BC-35-11	Limestone No. 1 of the Winchell formation, 2 miles southwest of Mercury (Bullard and Cuyler, 1935, p. 212).
BC-35-12	Limestone No. 4 of the Winchell formation, 2 miles northwest of Mercury (Bullard and Cuyler, 1935, p. 213).
BC-35-13	Placid shale, 23 to 35 feet above base, 1 mile north of Beef Pasture Tank on White Ranch (Bullard and Cuyler, 1935, p. 214).

Fossil localities listed by Williams (1938) are as follows:

Locality Number	Remarks
W-38-1	Brownwood shale, collection 7506, 3 miles east of Winchell (Williams, 1938, p. 153).
W-38-2	Brownwood shale, collection 7505, 10 feet above collection 7506, 3 miles east of Winchell (Williams, 1938, p. 153).
W-38-3	Adams Branch limestone, northwest of bridge over Colorado River at Winchell, Texas (Williams, 1938, p. 153).

W-38-4	Limestone No. 2 of the Winchell formation, 0.5 mile west of Winchell (Williams, 1938, p. 154).

Fossil localities listed by Plummer (1950) are as follows:

Locality Number	Remarks
P-50-1	Strawn, Plummer's locality 153-T-7, 3 miles northeast of Satuit, McCulloch County, south of Mercury Quadrangle (Plummer, 1950, p. 88).
P-50-2	Cedarton shale, Plummer's locality 153-T-21a, shale above Adams Branch limestone, 1.4 miles east of Placid (Plummer, 1950, pp. 96, 98).
P-50-3	Brownwood shale, Plummer's locality 153-T-23, shale below Rough Mountain conglomerate member of the Brownwood shale, south of Rough Mountain (Plummer, 1950, pp. 96, 98).
P-50-4	Strawn, Plummer's locality 153-T-98, 1.0 mile northeast of Rough Mountain (Plummer, 1950, pp. 96, 98).
P-50-5	Brownwood shale, Plummer's locality 153-T-100, 2.5 miles southeast of Placid (Plummer, 1950, pp. 96, 98).
P-50-6	Cedarton shale, Plummer's locality 153-T-113, shale below limestone No. 1 of the Winchell formation (Plummer, 1950, pp. 96, 99).

Microfossils have been identified by Early (1951) from two measured sections of the Brownwood shale (Figures 20 and 21). Sample numbers and the units from which the samples were obtained are as follows:

Brownwood shale, 2 miles east of Winchell (Figure 20)

Locality Number	Remarks
J-51-5 to 8	Unit 14, Figure 20

J-51-2, 3, and
J-50-53a, 54
to 58 . . . .. .Unit 13, Figure 20
J-51-28 to 30 .. .Unit 9, Figure 20
J-50-48 to 52. . .Unit 11, Figure 20
J-51-23 to 27. . .Unit 8, Figure 20
J-50-47 and
J-51-22. . . . .Unit 6, Figure 20
J-50-43 to 45. . .Unit 4, Figure 20
J-50-42. . . . . .Unit 2, Figure 20

Adams Branch limestone 0.5 mile southeast of Mercury (Figure 21)

J-51-32, 33,
and E-51-1 . . .Unit 20, Figure 21

Brownwood shale 0.5 mile southeast of Mercury (Figure 21)

E-51-2, 4, 5 . . .Unit 18, Figure 21
E-51-14 . . .. . .Unit 13, Figure 21

New fossil localities, some of which occur in measured sections, are as follows:

Locality Number	Remarks
J-51-1	Cedarton shale, just west of railroad in small valley on the northwest side of the hill between U. S. Highway 283 and the railroad, fossils weather out of shale and yellowish coquina 15-20 feet above base of Cedarton shale.
J-51-32,33	Adams Branch limestone, Unit 20, Figure 21.
J-51-50	Cedarton shale, about 20 feet from base, south of Mercury in railroad cut 0.4 mile northeast of U. S. G. S. bench mark 1505 feet.
J-51-51	Cedarton shale, southwest of Mercury in railroad cut, 100 feet south of U. S. G. S. bench mark 1505 feet, 15-20 feet above base of Cedarton.

J-51-52	Brownwood shale, Unit 9, Figure 21.
J-51-53	Cedarton shale, upper 15 feet of Cedarton 0.5 mile west of Mercury, just north of road between Mercury and U. S. Highway 283, collected by J. L. Wilson.
J-50-21	Strawn (Capps limestone member), road cut on farm road 1.0 mile east of Deep Creek at top of small hill.
J-50-24	Brownwood shale, 0-20 feet below base Rough Mountain conglomerate on west side of old Rochelle-Cowboy road, 0.1 mile north of elevation 1573 feet, same locality as Plummer's (1950) 153-T-23 or P-50-3.
J-50-41	Brownwood shale, Unit 1, Figure 20.
J-50-54 to 58	Brownwood shale, Unit 13, Figure 20.

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CORPS OF ENGINEERS

GEOLOGY
MERCURY QUADRANGLE
TEXAS
15 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION

QUATERNARY

Pleistocene and Recent

Qal — Alluvium
Alluvium deposited by Colorado River and major tributaries

Qg — Older gravels
Gravels deposited during an earlier erosion cycle, mapped in part only

CRETACEOUS

Lower Cretaceous

Ke — Edwards limestone

Kc — Comanche Peak limestone

Kw — Walnut formation

Kt — Travis Peak formation

PENNSYLVANIAN

Cisco

Pbc — Bluff Creek shale
Bunger limestone member (Pbcb)
White Ranch limestone member (Pbcw)

Canyon

Ph — Home Creek limestone

Pcy — Colony Creek shale

Pr — Ranger limestone

Pp, Ppc — Placid shale
Corn Creek limestone member (Ppc)

Pw — Winchell formation
Base No. 4, No. 3, Top No. 2
Limestone beds numbered 1 through 5 from base to top of formation

Pc — Cedarton shale

Pa — Adams Branch limestone

Pb — Brownwood shale
Rough Mtn. conglomerate member (Pbrm)
Rochelle conglomerate member (Pbr)

Strawn

Pcp — Capps limestone member

Pst — Strawn undifferentiated

Bend

Psm — Smithwick shale

Pbs — Big Saline formation

MISSISSIPPIAN

Mb — Barnett shale

Mi — Ives breccia

ORDOVICIAN

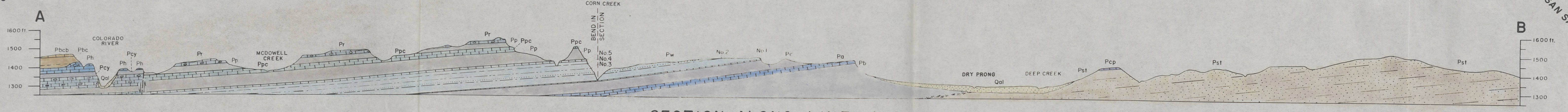
Lower Ordovician

Oeg — Gorman formation

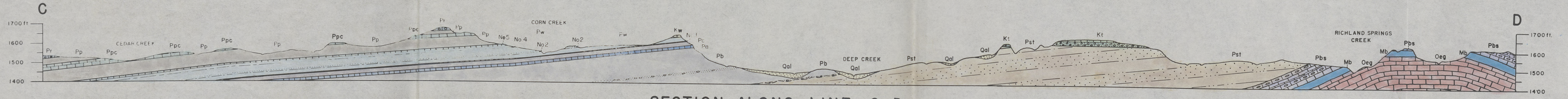
Contacts — Faults (U, D)
Solid where believed accurate to scale of map.
Dashed where inferred or adjusted to topography.

Reefs

Channel sandstones and conglomerates



SECTION ALONG LINE A-B



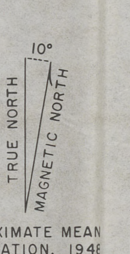
SECTION ALONG LINE C-D

Base map by the Geological Survey, edition of 1950

Control by USGS and USC&GS

Culture and drainage in part compiled from aerial photographs taken 1938
Topography by plane-table methods 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Texas coordinate system, central zone



APPROXIMATE MEAN DECLINATION, 1948

GEOLOGIC MAP
OF THE
MERCURY QUADRANGLE, TEXAS

By William A. Jenkins, Jr.

1 ½ 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

1952

Geology mapped in 1951

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS
Heavy-duty
Loose-surface, graded, or narrow hard-surface

DRY WEATHER ROADS
Improved dirt
Unimproved dirt

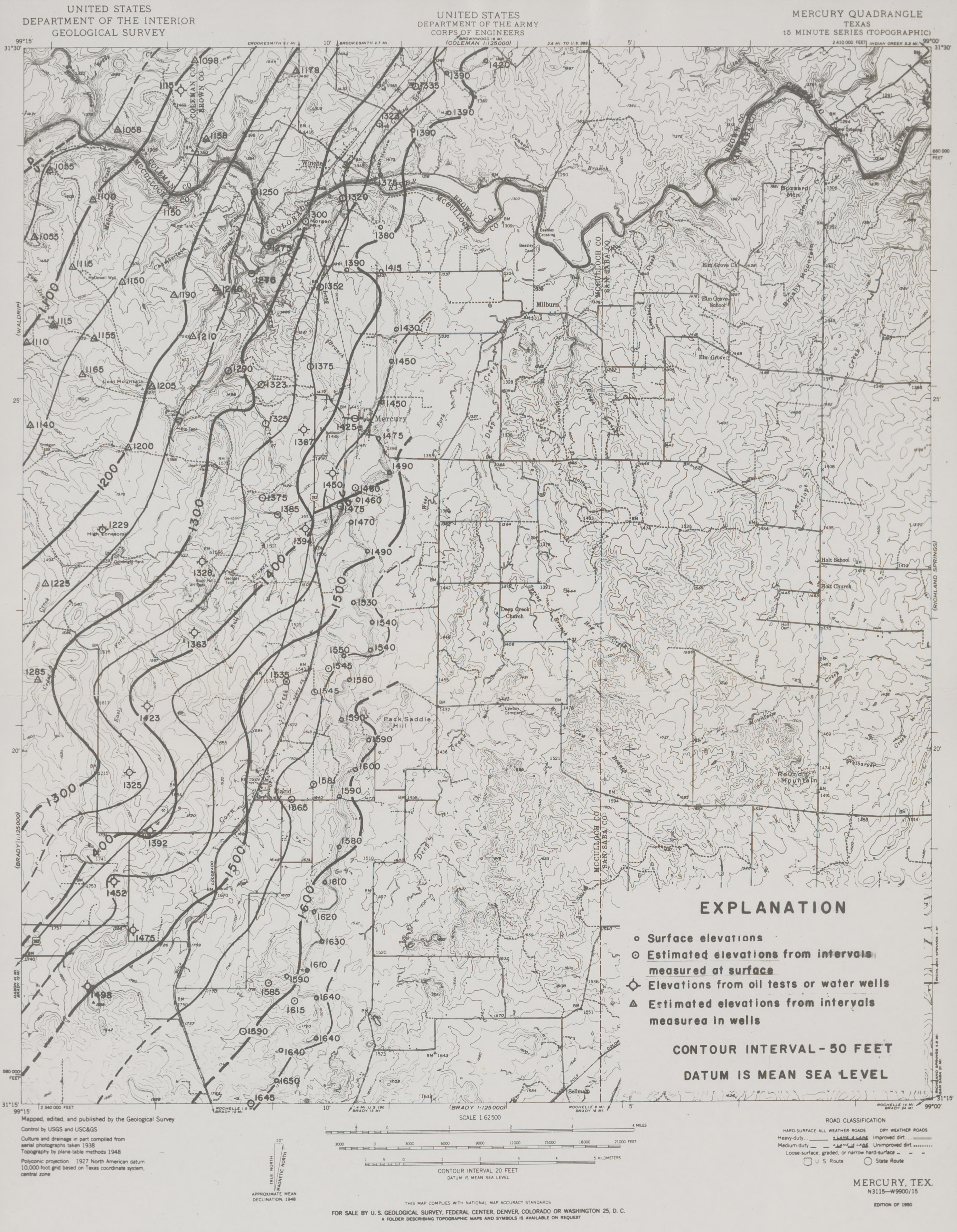


Plate 2. - Structure contour map of the western half of the Mercury Quadrangle on the base of the Adams Branch limestone.

Plate 3. - Map showing fossil localities in the Mercury Quadrangle. "BC" numbers are localities described by Bullard and Cuyler (1935); "W" numbers, Williams (1938); "P" numbers, Plummer (1950); "E" numbers, Early (1951); and "J" numbers new localities (this report). Description of localities can be found in Appendix A, and distribution of species, in Table 1.

Table I.- Distribution of species in various formations in the Mercury Quadrangle.

	P-50-1	P-50-4	J-50-21	BC-35-1	W-38-1	W-38-2	P-50-3	P-50-5	E-51-2	E-51-4	E-51-5	E-51-14	J-50-24	J-50-41	J-50-42	J-50-43	J-50-44	J-50-45	J-50-47	J-50-48	J-50-49	J-50-50	J-50-51	J-50-52	J-50-53a	J-50-54	J-50-55	J-50-56	J-50-57	J-50-58	J-50-54 to 58 (megafossils)	J-51-2	J-51-3	J-51-5	J-51-6	J-51-7	J-51-8	J-51-22	J-51-23	J-51-24	J-51-25	J-51-26	J-51-27	J-51-28	J-51-29	J-51-30	J-51-52	W-38-3	J-51-32	J-51-33	E-51-1	J-51-32,33 (megafossils)	BC-35-2	BC-35-3	BC-35-4	BC-35-5	P-50-2	P-50-6	J-51-1	J-51-50	J-51-51	J-51-53	BC-35-6	BC-35-7	BC-35-9	BC-35-10	BC-35-11	BC-35-12	W-38-4	BC-35-8	BC-35-13
	STRAWN			BROWNWOOD																																												ADAMS BRANCH					CEDARTON											WINCHELL							PLACID	
BRACHIOPODA																																																																							
Cerurithyris planoconvexa (Shumard)																																																								X																
Chonetes granulifer Owen				X																																																	X																		
Chonetina flemingi (Norwood and Pratten)													X																																												X														
C. flemingi var. plebeia Dunbar and Condra		X																																																																					
C. robusta R.H. King	X																																																																						
C. rostrata Dunbar and Condra		X																																																																					
Chonetes verneuilianus Martin																																																						X																	
Cleiothyridina orbicularis McChesney	X																																																																						
Composita argentea (Shepard)																																																									X														
C. ovata Mather																																																												X	X											
C. subtilita (Hall)					X	X																																									X	X				X	X	X					X		X	X		X			X	X	X	X	
Crania modesta White and St. John	X																																																																						
Cryptacanthia whitei Dunbar and Condra																																																									X														
Derbyia bennetti Hall and Clarke	X																																																																						
Derbyia crassa (Meek and Hayden)	X	X				X																																																						X	X										
Derbyia crassa var. subcircularis Dunbar and Condra																																																									X														
Dictyoclostus americanus Dunbar and Condra																																																										X													
D. crassicostatus Dunbar and Condra																																																									X														
D. portlockianus Norwood and Pratten					X																																																																X		
D. sp.	X																																																																						
Echinoconchus semipunctatus (Shepard)													X																																		X																X		X	X									
Hustedia mormoni Marcou				X																																																X			X	X			X			X									
Juesania nebrascensis (Owen)	X																																																																						
J. nebrascensis n. var. aff. J. ovalis (Dunbar and Condra)						X																																																																	
J. symmetrica (McChesney)		X																																																																					
J. sp.																																																													X										
Marginifera lasallensis (Worthen)													X																																									X		X		X	X		X										
M. muricatina Dunbar and Condra	X																																																																							
M. splendens (Norwood and Pratten)	X																																																																							
M. wabashensis (Norwood and Pratten)																																																									X														
Mesolobus mesolobus (Norwood and Pratten)	X																																																																							
M. mesolobus var. rochellensis R. H. King	X																																																																							
Neospirifer cameratus Morton			X	X																																																	X															X			
N. dunbari R. H. King	X																																														X												X		X	X									
N. texanus (Meek)														X																																	X					X					X		X												
N. triplicatus (Hall)					X																																																																		
Orbiculoidea missouriensis (Shumard)																																																									X														
Punctospirifer kentuckyensis (Shumard)	X			X																																																	X		X	X			X			X									
Rhipidomella carbonaria (Swallow)	X																																																																						
R. carbonaria var. subcircularis R. H. King	X																																																																							
Rhynchopora magnicosta Mather	X																																																																							
Spirifer rockymontanus Marcou	X																																																																							
PELECYPODA																																																																							
Astartella concentrica (Conrad)						X		X					X																		X																												X												
Aviculopecten arctisulcatus Newell		X																																																																					
A. sp.														X																																																									
Conocardium parrishi Worthen																																																									X														
Deltopecten texanus? Girty						X																																																																	
Myalina subquadrata Shumard						X																																									X									X										X					X
M. wyomingensis (Lea)		X																																																																					
M. sp.		X		X																																																																			
Nucula anodontoides Meek							X						X																		X																															X									
Nuculana arata (Hall)																																																									X														
Pleurophorus sp.?		X																																																																					
Septimyalina perattenuata (Meek and Hayden)								X																																																																
GASTROPODA																																																																							
Amphiscapha catilloides (Conrad)							X	X					X																																					X																						
Baylea subconstricta (Meek and Worthen)	X																																																																							
Bellerophon sp.																																																													X								X		
Bucanopsis meekiana (Swallow)							X																																																																
Euphemites sp. indet.							X																																																																
Glabrocingulum grayvillense (Norwood and Pratten)													X																																								X									X									
G. cf. G. grayvillense (Norwood and Pratten)							X	X																																																		X												
Meekospira peracuta (Meek and Worthen)							X	X					X																																																	X									
Orthonema marvinwelleri?	X																																																																						
Pharkidonotus percarinatus (Conrad)													X																		X																															X									
Phymatopleura modosa (Girty)							X																																																																
Sphaerodoma primogenium (Conrad)							X																																																																
Trepospira depressa (Cox)																																																												X			X									
T. discoidalis Newell							X						X																																												X														
Worthenia tabulata (Conrad)							X						X																																								X						X			X									
CEPHALOPODA																																																																							
Liroceras liratum (Girty)																																																									X														
Pseudorthoceras knoxense McChesney																																																					X																		
ANTHOZOA																																																																							
Lophophyllum profundum Milne-Edwards and Haime	X												X																		X																X									X			X	X		X			X					X	
L. radicosum Girty	X												X																																		X						X						X			X									
BRYOZOA																																																																							
Fenestella sp.						X																																																																		
Fistulipora nodulifera Meek																																																					X																		
Polypora sp.						X																																															X																		
Rhombopora lepidodendroidea Meek						X																																															X																		
Tabulipora sp.																																																					X																		
ECHINODERMA																																																																							
Ancistrum ludwigi?																					X		X	X						X														X		X																									
Archeocidaris sp.																																																					X			X															
Ethelocrinus sp.	X																																																																							
Paleochiridota plummerae Croneis											X																																																												
Platycrinus sp.	X																																																																							
Plaxocrinus sp.													X																																																										
Protocaudina kansasensis (Hanna)											X																																								X																				
FORAMINIFERA																																																																							
Ammobaculites stenomeca Cushman and Waters																																			X	X								X																											
Ammodiscus semiconstrictus Waters											X								X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X																				
Apterinella sp.																					X						X			X																																									
Calcivertella adherens? Cushman and Waters											X											X					X			X								X						X																											
Endothyra sp.																											X			X																																									
Endothyranella nitida (Waters)											X															X																									X																				
Fusulina rickerensis Thompson	X																																																																						
Fusulina sp.			X																																																																				
Glomospira diversa Cushman and Waters																									X																																														
G. reversa Cushman and Waters											X														X																																														
Hyperamminoides elegans (Cushman and Waters)																		X				X											X			X				X		X																													
H. proteus (Cushman and Waters)																	X	X							X							X	X	X	X	X				X				X	X	X																									
Orthovertella protea Cushman and Waters																									X	X				X														X																											
O. sellardsi Plummer																									X	X	X	X		X																																									
O. sp.																					X							X		X																																									
Polytaxis scutella (Cushman and Waters)											X														X																																														
Triticites irregularis (Schellwein and Staff)																																																										X													
OSTRACODA																																																																							
Amphissites centronotus (Ulrich and Bassler)											X					X									X																								X	X	X																				
A. ciscoensis Harlton											X																																								X																				
A. girtyi Knight											X																																								X																				
Bairdia oklahomaensis Harlton																						X								X																			X	X																					
Cavellina lintris Coryell and Sample											X					X					X	X	X	X				X		X									X			X	X		X				X																						
Coryellites johnsoni (Upson)											X						X		X		X	X				X	X	X	X	X									X			X		X							X																				
Cornigella tuberculospinosa Jones and Kirkby											X										X	X	X	X																				X	X																										
Ectodemites dattonensis (Harlton)										X	X																							X															X	X																					
Healdia colonyi Coryell and Booth																												X		X																																									
H. marginata? Harlton																														X																																									
H. oklahomaensis Harlton											X	X								X	X	X	X	X	X	X	X	X	X	X											X				X				X																						
Hollinella regularis Coryell											X					X					X					X																								X																					
Kirkbya firma Kellett											X																																																												
Knightina ampla Kellett											X																																																												
Macrocypris menardensis Harlton																					X																																																		
Moorites minutus (Warthin)										X	X									X	X	X	X	X	X		X			X								X			X	X		X	X				X																						
Sansabella carbonaria Cooper																						X																				X		X																											
CONODONTA																																																																							
Cavusgnathus flexa Ellison											X				X	X									X																										X																				
C. giganta Gunnell											X				X	X			X			X	X															X																																	
C. lauta Gunnell											X				X	X						X		X	X	X												X													X																				
C. sp.															X	X								X	X																X																														
Gondella elegantula Stauffer and Plummer											X																																																											
Hibbardella sp.											X																																																												
Hideodella sp.											X				X	X	X					X	X		X			X	X	X																			X	X	X																				
Idiognathodus delicatus Gunnell									X	X	X															X			X																				X	X	X																				
Ligonodina sp.											X				X																							X																																	
Ozarkodina delicatula Branson and Mehl											X				X	X													X									X												X	X																				
Prioniodus sp.																																																			X																				
Streptognathodus elegantulus Stauffer and Plummer										X	X				X	X									X	X			X	X																			X	X	X																				
S. excelsus Stauffer and Plummer											X					X										X																							X	X																					
S. gracilis Stauffer and Plummer											X					X																																	X	X	X																				
S. minutus (Ellison)										X	X				X																																			X	X																				
S. appletus Ellison											X																																						X		X																				
S. sp.											X																																								X																				
Synprioniodina sp.																X																																	X																						